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NUCLEAR SCIENCE ABSTRACTS

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NOTICE

A title page for Volume 18, Numbers 19–24, is included at the back of this issue for use in binding the fourth quarter of this volume.

CORRECTIONS

NSA Vol. 16, No. 15, p. 2578. In abstract 19840, report number GCA-TR-61-39-A should be GCA-TR-61-38-A.

NSA Vol. 16, No. 21, p. 3845. In abstract 29359, in descriptive cataloging, Technical Quarterly Report No. 2 should be No. 3.

NSA Vol. 16, No. 24, p. 4430. In abstract 33460, in descriptive cataloging, Quarterly Report No. 3 should be No. 4.

NSA Vol. 17, No. 2, p. 267. In abstract 1902, in descriptive cataloging, Quarterly Report No. 4 should be No. 5.

NSA Vol. 17, No. 11, p. 2443. In abstract 18720, in descriptive cataloging, Quarterly Technical Report No. 5 should be No. 6.

NSA Vol. 17, No. 13, p. 2898. In abstract 22136, in descriptive cataloging, Quarterly Report No. 6 should be No. 7.

NSA Vol. 17, No. 17, p. 3843. In abstract 29133, report number UCRL-6254(p.27-31) should be UCRL-7254(p.27-31).

NSA Vol. 17, No. 19, p. 4306. In abstract 32264, in line five of descriptive cataloging, (CONF-136-1) should be (CONF-16-16).

NSA Vol. 17, No. 23, p. 5223. In abstract 38898, in line two of descriptive cataloging, III should be V.

NSA Vol. 18, No. 1, p. 59. In abstract 372, line one of descriptive cataloging, Project Pre-Buggy should be moved to line four following Sept. 1, 1963.

NSA Vol. 18, No. 1, p. 59. In abstract 372, report number PNE-304 should be PNE-304F.

NSA Vol. 18, No. 8, p. 1676. In abstract 12471, journal reference At. Kozlemen., 11: 465-9(1963) should be Magy. Tud. Akad. Kozp. Fiz. Kut. Int. Kozlemen.

NSA Vol. 18, No. 11, p. 2327. In abstract 17412, journal reference Biol. Nauki should be Nauchnye Doklady Vysshei Shkoly. Biol. Nauki.

NSA Vol. 18, No. 11, p. 2565. In abstract 19104, in descriptive cataloging, add (Phys. Rev., 134: B378-82(Apr. 27, 1964)) after (Princeton Univ., N. J.).

NSA Vol. 18, No. 15, p. 3503. In abstract 25945, in descriptive cataloging, Quarterly Technical Report No. 11 should be No. 12.

NSA Vol. 18, No. 16, p. 3805. In abstract 28182, line thirteen of abstract ... of 200 nsec or $\Delta E = \pm 2\%$ should be ... of 200 nsec or $\Delta E = \pm .2\%$.

NSA Vol. 18, No. 17, p. 3939. In abstract 29258, journal reference Aerospace Med., 37: 636-9 should be Aerospace Med., 34: 626-9.

NSA Vol. 18, No. 17, p. 4023. In abstract 29854, for abstracts of individual papers, abstract number 20928 should be 30928.

NSA Vol. 18, No. 20, p. 4778. In abstract 35642, the title should be Chemical Technology Division, Unit Operations Section Monthly Progress Report, January 1964.

NSA Vol. 18, No. 20, p. 4791. In abstract 35727, line five of descriptive cataloging, (CONF-136) should be (CONF-16).

NSA Vol. 18, No. 21. The subject category of abstract 37755 should be changed to Chemistry-Radiation Chemistry and Radiochemistry.

NSA Vol. 18, No. 21. The subject category of abstract 37862 should be changed to Reactor Technology-Criticality Studies.

NSA Vol. 18, No. 21. The subject categories of abstracts 38006, 38007, 38008, 38009, 38010, 38011, 38012, and 38013 should be changed to Physics-Neutron Physics.

NSA Vol. 18, No. 21. The subject category of abstract 38062 should be changed to Physics-Shielding.

NSA Vol. 18, No. 22, p. 5348. In abstract 39600, in line three of descriptive cataloging, (CONF-649-1) should be (CONF-649-2).

Volume 18, Number 24, December 31, 1964

NUCLEAR SCIENCE ABSTRACTS

A semimonthly publication of the USAEC Division of Technical Information, Edward J. Brunenkant, Director.
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Volume 18, Number 24 December 31, 1964

NUCLEAR SCIENCE ABSTRACTS

BIOLOGY AND MEDICINE

General

43149 (CONF-698-1) THE ROLE OF LIGHT IN EVOLUTION. [THE TRANSITION FROM A ONE-QUANTUM TO A TWO QUANTA MECHANISM]. Hans Gaffron (Florida State Univ., Tallahassee. Inst. of Molecular Biophysics and Florida State Univ., Tallahassee). [1964]. Contracts AT(40-1)-2687 and NONR-988-(10). 23p.

From the Origin of Prebiological Systems, Wakulla Springs, Fla., Oct. 1963.

The role of light in evolution is reviewed with emphasis on the importance of the development of photosynthetic reactions. Data are reported from studies in algae and anaerobic bacteria of reactions likely to have happened under early earth conditions. Reaction systems involved in the synthesis of organic matter from CO_2 and current beliefs on the succession of evolutionary eras are reviewed. A schematic attempt was made to explain the relationship between complete photosynthesis and photoreduction without oxygen evolution in normal green algae. (C.H.)

43150 (HW-SA-3715) BIOLOGY RESEARCH AT HANFORD LABORATORIES. [R. Thompson] (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). [Sept. 15, 1964]. Contract [AT(45-1)-1350]. 81p.

The development of the program of biological research at Hanford Laboratories is reviewed. Since 1950, personnel have more than doubled and laboratory facilities have been expanded to accommodate an enlarged program. The early emphasis on monitoring has been gradually replaced with a broader concern for radionuclide metabolism and radiation effects, in general, and with studies utilizing radiation and radionuclides in the investigation of biological problems unrelated to radiation. The past 10 years have seen the development of a number of research areas. Miniature swine are extensively employed in studies of radionuclide metabolism and toxicology. This animal is, in many respects, an appropriate stand-in for man. A pure-bred colony of approximately 200 beagles is employed in a broad program of inhalation studies. A field and laboratory ecology program, making use of radionuclide tracer techniques, has largely supplanted the earlier program of biological monitoring of the Hanford environs. This program has not only utilized the extensive controlled environs of the Hanford reservation, but has also been involved with studies of fallout throughout the Northwest and in Alaska. A list is included of recent representative publications. (C.H.)

43151 (ISS-63/50) IL SEMINARIO DEI LABORATORI DI FISICA NEL QUADRIMESTRE SETTEMBRE–DICEMBRE 1963. (The Seminar at the Physics Laboratory During the Period September–December 1963). (Italy. Istituto Superiore di Sanità, Rome). Dec. 30, 1963. 100p.

Lectures (20) on computer use and programming, crystallographic calculations, radiation dosimetry, x-ray spectroscopy, cell differentiation, structure of nerve endings, interaction of aminoacridines with nucleic acids, nuclear magnetic resonance, coordination compounds containing ligands, electron-electron scattering, elementary particles, Mössbauer effect, superfluidity theory, photoproduction, beta decay, and excited states of nonspherical nuclei are summarized. (D.C.W.)

43152 (LA-3132-MS) BIOLOGICAL AND MEDICAL RESEARCH GROUP (H-4) OF THE HEALTH DIVISION ANNUAL REPORT, JULY 1963–JUNE 1964. (Los Alamos Scientific Lab., N. Mex.). July 1964. Contract W-7405-eng-36. 274p.

Separate abstracts were prepared for 33 sections of this report. A list is included of publications during the period covered by this report. (C.H.)

For abstracts of individual papers see: 43153, 43154, 43155, 43156, 43157, 43158, 43171, 43172, 43173, 43174, 43175, 43176, 43177, 43178, 43179, 43180, 43181, 43182, 43220, 43319, 43374, 43375, 43444, 43541, 43542, 43543, 43544, 43545, 43801, 43833, 43934, 43935, and 44020.

43153 (LA-3132-MS(p.103-8)) VETERINARY MEDICINE AND SURGERY IN THE BIOLOGICAL AND MEDICAL RESEARCH GROUP. J. C. Hensley, G. E. Oakley, and E. A. Vigil (Los Alamos Scientific Lab., N. Mex.).

Procedures used for the maintenance of colonies of mice, dogs, and monkeys in virtually perfect health states are discussed. Diagnostic procedures and treatment methods used for clinical conditions are outlined. (C.H.)

43154 (LA-3132-MS(p.182-207)) ELECTRONIC CELL SIZING. (Los Alamos Scientific Lab., N. Mex.).

Applications of the Coulter electronic cell counter in measurements of the volume distribution of erythrocytes and other cells are discussed. Improvements in experimental apparatus and techniques are reported. It is recommended that the aperture current used be the smallest possible, in order to minimize possible electrical effects on the cells and physical phenomena at the aperture. Calibration of the pulse height in terms of apparent volume was performed by measuring a saline suspension of ragweed

pollen, since pollen grains are unaffected by the current used. The experimental arrangement was used to compare the spectra of uniform polystyrene spheres and the much larger, less uniform ragweed pollen grains. Results are reported for volume measurements of human erythrocytes. (C.H.)

43155 (LA-3132-MS(p.208-12)) THE EFFECT OF ACTINOMYCIN D ON PREMITOTIC CELLS. R. A. Tobey and D. F. Petersen (Los Alamos Scientific Lab., N. Mex.).

Preliminary experiments on the effect of actinomycin on mitosis in synchronized cultures of Chinese hamster ovary cells are described. By accurately predicting the appearance of mitosis in cell cultures well in advance of the actual event, it was possible to introduce specific inhibitors at preselected times prior to division and to observe the effect on the subsequent mitotic wave. Results indicated that biosynthetic activity essential to successful cell division occurs very late in G_2, while cells already in prophase at the time of actinomycin addition proceed through mitosis and divide at the normal rate. (auth)

43156 (LA-3132-MS(p.218-23)) A STABLE PROTEIN FRACTION ASSOCIATED WITH THE MITOTIC APPARATUS. D. F. Petersen, F. Sapir, and E. C. Anderson (Los Alamos Scientific Lab., N. Mex.).

It was previously suggested that histones influence in some way the expression of genetic information. Results are reported from studies using cultured Chinese hamster ovary cells that have remained nominally diploid in which a stable fraction of basic nucleoprotein associated with the mitotic apparatus appears to be synthesized only once per generation, consistent with the idea that histones act to regulate transcription of genetic information in a manner temporally appropriate to the sequence of biochemical events occurring at various times in the life cycle of the mammalian cell. (auth)

43157 (LA-3132-MS(p.236-9)) PURIFICATION OF DNA POLYMERASE FROM ESCHERICHIA COLI. R. L. Ratliff and T. T. Trujillo (Los Alamos Scientific Lab., N. Mex.).

A procedure is described for the purification of large quantities of DNA polymerase from Escherichia coli. Even after purification of about 300-fold over the initial extract, the enzyme still had nuclease activity. (C.H.)

43158 (LA-3132-MS(p.240-1)) PURIFICATION OF RNA POLYMERASE FROM ESCHERICHIA COLI. R. L. Ratliff and T. T. Trujillo (Los Alamos Scientific Lab., N. Mex.).

A procedure is described for the purification of RNA polymerase from Escherichia coli. (C.H.)

43159 (ORNL-TM-803) ZAP-1—A PROGRAM TO CALCULATE RADIATION DOSE RATES NEAR A SPHERICAL SOURCE. P. A. Thompson, S. A. Lewis, T. G. Clark, B. R. Fish, and R. H. Boyett (Oak Ridge National Lab., Tenn.). Oct. 1964. Contract W-7405-eng-26. 59p.

A computer program which determines the dose from a spherical source as a function of depth in tissue is described. Basic physical laws are used to formulate a model for the interaction of radiation with matter. Transitions between energy levels and between beta and gamma rays are the distinguishing features of this program. At present geometrical considerations limit its usefulness; however, experimental values support the validity of the model. The program was written in CODAP-1 and FORTRAN 62 for CDC 1604. (auth)

43160 (SAN-1023) APPLICATION OF RADIOCHEMISTRY TECHNIQUES IN FOOD PROCESSING RESEARCH. RADIOISOTOPIC TRACER TECHNIQUES IN EVALUATION AND IMPROVEMENT OF INDUSTRY PRACTICES FOR REMOVAL OF PESTICIDE RESIDUES FROM FOODS. Annual Progress Report No. 3. Walter A. Mercer, ed. (National Canners Assn. Washington Research Labs., Washington, D. C. and National Canners Assn. Western Research Lab., Berkeley, Calif.). Feb. 15, 1964. Contract AT(04-3)-296. 116p.

An environmental chamber for the growth of crops treated with radioactive pesticides was designed and constructed. The chamber permits the safe preparation of crop samples which have pesticide residues comparable in condition and concentration to those found in commercially grown crops. By use of the chamber, crops were grown under controlled conditions of light, temperature, and nutrition. Details for the construction and operation of the chamber are recorded. Two methods for the preparation of tritium-labeled DDT are reported. The bulk of the DDT-H^3 used in the research was prepared by the Wilzbach technique. Extensive purification of the crude sample, obtained after the tritium exposure, was required to get a homogeneous preparation of DDT. Chemical degradation of the DDT-H^3 established that 92% of the tritium was in the benzylic-H position. Recovered DDT-H^3 from sprayed tomato plant foliage (after a three week growth period) had no change in specific activity. Spinach was grown from seed, the seedlings sprayed with radioactive pesticide, and the crop grown to harvest maturity in the chamber. Spinach samples were taken periodically throughout the entire growth period of the crop. Very little pesticide was lost by weathering under the simulated conditions of the chamber. The major factor in the reduction of pesticide level was the dilution by increased crop weight after growth. Autoradiography of spinach samples sprayed with DDT-C^{14} were employed to determine spray patterns, distribution, translocation, and breakdown of the pesticide. Autoradiograms of a spinach seedling taken immediately after spraying indicated an even distribution of activity. Twenty-one days after spraying the DDT-C^{14} was concentrated in the older mature leaves and essentially absent from the leaves which were younger and smaller at the time of spraying. Autoradiography provided evidence for leaf-to-root translocation of DDT in spinach. No evidence for breakdown products from DDT was obtained. The pilot plant was modified to allow for the washing of leafy vegetables by incorporating a reel washer in the third stage. In this equipment the leafy vegetable was agitated in a rotating drum which allowed spray water to cleanse the entire leaf surface. The washing and blanching of spinach was effective in reducing DDT-H^3 residues by substantial factors. 58% of the DDT-H^3 present on spinach samples grown in the environmental chamber was removed by detergent washing of the leaves. When lower DDT residue levels were obtained by spraying mature spinach, 44% of the residue was removed by detergent washing followed by blanching. Radiochemical techniques were used to evaluate and improve analytical methods for pesticide residues. The methods, after careful checking, will be incorporated in a Handbook of Pesticide Residue Control and Methodology. A new technique for extraction of pesticide residues from fruits and vegetables was developed; this technique uses charcoal in the blending step of the extraction to accomplish a partial clean-up. Recoveries of radioactive aldrin, dieldrin, and DDT ranged from 93 to 100%

using the new extraction technique on samples prepared from apples, apricots, carrots, cauliflower, sweet potatoes, tomatoes, and spinach. Vacuum sublimation, as a method of pesticide residue sample clean-up, showed considerable promise with recoveries ranging from 61 to 100% for a large number of pesticides. A detailed technique for the analysis of chlorinated hydrocarbon pesticides by paper chromatography was developed and tested. The analysis of chlorinated hydrocarbon pesticides by thin-layer chromatography was developed and the R_f value for 18 pesticides in 4 solvent systems recorded. Preliminary work on the analysis of organophosphate pesticides by thin-layer chromatography gave promising results; R_f values were established for 7 pesticides in 3 solvent systems. Electron capture gas chromatography was explored as a technique for pesticide residue analysis. Retention times for 33 pesticides on 3 columns were recorded. A new approach of preliminary halogenation of pesticides which do not normally cause electron capture detector response was studied; a technique for the analysis of Sevin on green beans at the one ppM level was developed. The fly bioassay method was studied to improve its reliability. Improvement of the erratic nature of the assay was achieved by controlling the age of the flies used to 2 ± 0.25 days. The masking effect of plant extractives was reduced by passing the extracts through a Florisil column prior to assay. Surfactants added to the assay jars gave no significant improvement. (auth)

43161 QUANTUM ASPECTS OF POLYPEPTIDES AND POLYNUCLEOTIDES. A Symposium Held at Stanford University, California, March 25-29, 1963. M. Weissbluth, ed. Biopolymers Symp., No. 1, 1-565(1964). New York, Interscience Publishers, 1964.

Papers (42) on topics related to quantum interpretation of biology are presented, dealing primarily with the experimental and theoretical features of the interaction of electromagnetic radiation with polynucleotides and polypeptides. Separate abstracts were prepared for five papers. (D.C.W.)

For abstracts of individual papers see: 43162, 43163, 43164, 43609, and 43610.

43162 EFFECT OF PROTON TUNNELLING IN DNA ON GENETIC INFORMATION AND PROBLEMS OF MUTATIONS, AGING, AND TUMORS. Per-Olov Loewdin (Univ. of Florida, Gainesville and Uppsala Univ.). Biopolymers Symp., No. 1, 161-81(1964).

In quantum mechanics, the proton is a wave packet which may penetrate the potential barrier through the tunnel effect. As a consequence, there is a finite probability that the normal base pairs A−T and G−C may spontaneously go over into the tautomeric pairs A*−T* and G*−C* through a proton exchange along the hydrogen bonds. Since the tautomeric bases have another pairing pattern (A*−C, G*−T, C*−A, T*−G), the proton exchange leads inevitably to errors in the genetic base sequence in the next duplication. This mechanism may be responsible for the occurrence of spontaneous mutations, aging (considered as a loss of useful genetic information through accumulation of errors), and the occurrence of spontaneous cancer when the accumulated errors have passed a critical limit in a certain direction. Even many induced biological phenomena may ultimately depend on proton tunnelling, and a series of possibilities is discussed. Some brief comments on the possible mechanisms for the replication and transcription of the genetic message are further given. (auth)

43163 *SOME ASPECTS OF QUANTUM BIOLOGY.* Per-Olov Loewdin (Univ. of Florida, Gainesville and Uppsala Univ.). Biopolymers Symp., No. 1, 293-311(1964).

The general theory of life processes and the functioning of the cell on the molecular and submolecular level is discussed on the basis of the assumption that matter consists of only a few elementary particles (electrons, protons, neutrons, photons) which obey the laws of modern quantum mechanics. It is pointed out that the time-dependent Schrödinger equation is conveniently solved by means of the evolution operator, and that the main difficulties actually lie in determining the relative phase distribution of the initial wave function in a given situation. The concept of transition probabilities is analyzed with particular reference to the phase problem, the difference between coherent and incoherent phenomena in wave mechanics is pointed out, and the time irreversibility connected with the random-phase postulate is demonstrated. It is emphasized that biological reactions may often have a large amount of coherent nature characterized by well-ordered wave patterns, and that one cannot a priori assume that the laws of ordinary statistical mechanics should be generally valid. A review of some fundamental problems in quantum biology is given, dealing with the problem of the stability of the molecular skeletons and the localized σ-electrons, the importance of the mobile electrons, the key role of the protons and the hydrogen bonds and the transport phenomena associated with the transfer of energy, momentum, charge, etc., in living systems. (auth)

43164 TOWARDS QUANTUM BIOLOGY. G. Karreman (Univ. of Pennsylvania, Philadelphia). Biopolymers Symp., No. 1, 313-24(1964).

Electronic aspects of some biologically active molecules are discussed. It is pointed out that with reasonable assumptions the effective width of the phase boundary potential at the surface of cells, in which ions adsorb at fixed charges, agrees with the thickness usually ascribed to a cell membrane. A discussion is given of the basic importance for quantum biology of the process of chemical induction leading to cooperative phenomena with propagation and amplification of shifts of electronic charges in proteins. A description is given of a method using numerical analysis to treat a problem in quantum mechanics which is important for the transmission of shifts of electronic charges by induction. (auth)

43165 PROGRESS IN BIOPHYSICS AND BIOPHYSICAL CHEMISTRY. VOLUME 11. J. A. V. Butler, B. Katz, and R. E. Zirkle, eds. Progr. Biophys. Biophys. Chem., 11: 1-277(1961). New York, Pergamon Press, 1961.

Separate abstracts were prepared for three sections of this book. Topics discussed in other sections include neural organization, the dispersion of indicator substances in the mammalian circulation, the buoyancy of fish and cephalopods, and the role of cytoplasmic particles in protein synthesis. (C.H.)

For abstracts of individual papers see: 43210, 43276, and 43349.

43166 BIBLIOGRAPHY OF BONE TRANSPLANTATION. ADDENDUM VI. C. A. L. Bassett and A. Rueedi-Lindecker (Columbia Univ., New York). Transplantation, 2: 668-79(Sept. 1964).

Annotated references are presented to 199 journal articles in the field of bone transplantation. Topics covered include: fresh autogenous grafts in animals; preserved homogeneous grafts in humans; preserved homogeneous

grafts in animals; fresh homogeneous grafts in animals; preserved heterogeneous grafts in humans; preserved heterogeneous grafts in animals; bone banks; bone metabolism; tissue culture studies; bone induction studies; review articles; bone graft substitutes; and osteogenesis. A subject index is included. (H.M.G.)

Ecology

43167 (BNL-8228) RADIATION, DDT AND BIOLOGY. G. M. Woodwell (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract AT-30-2-GEN-16. 7p. (CONF-677-1)

From 3rd Annual Congress of Scientists on Survival, New York, June 1964.

The ecological effects of biologically active materials introduced in large quantities to the general environment are discussed. Fission products in fallout resulting from nuclear explosions can be used to elucidate the circulation of atmosphere and oceans and to clarify the cycles characteristic of organisms, populations, and ecological systems. It is postulated that chlorinated hydrocarbon insecticides, such as DDT, are now widely distributed over the face of the earth and traces may be found in water supplies, in most wildlife, and in the fat of most humans. Some of the scientific questions involved in the manipulation of environment for the advantage of man are discussed and illustrated by application of fallout and DDT. (C.H.)

43168 (CONF-147-12) RADIOTRACKING OF DUCKS, DEER AND TOADS. Technical Report No. 6. John R. Tester (Minnesota. Univ., Minneapolis. Museum of Natural History). Dec. 1963. Contract AT(11-1)-899. 9p. (TID-20910)

From Instrument Society of America Conference, Chicago, Sept. 1963.

The use of miniature radio transmitters and directional receivers in studies on the movements of deer, ducks, and toads are described. Results show that basic radio tracking equipment may be used for locating species with widely differing patterns of mobile behavior. Applications of this technique in ecological studies are discussed. (C.H.)

Metabolism, Tissue Distribution, and Toxicology

Refer also to abstract 43808.

43169 (AD-439063) STUDIES ON DEOXYRIBONUCLEIC ACID METABOLISM. Quarterly Report No. 2, April 15–July 14, 1962. Yasuyuki Takagi (Kanazawa Univ., Ishikawa Prefecture, Japan. Medical School). Contract DA92-557-FEC-34525. 7p.

An attempt was made to analyze effects of irradiation or treatment with various radiomimetic compounds which result in interference of DNA synthesis as well as the induction of mutations, in order to clarify the real biochemical events of DNA formation involved in cell division. During this quarterly period the following experiments were performed in order to continue the efforts to test this possibility. DNA preparations were extracted from E. coli and Alcaligenes faecalis treated with various levels of mitomycin C (MC) for different time periods, and purified by several kinds of procedure including phenol extraction; sodium lauryl sulfate extraction, alcohol precipitation. It was found in some cases that the formation of DNA with the DNA preparation of MC-treated cells added as the primer of the polymerizing reaction occurred at almost the half level compared to that with DNA prepared from the untreated control organisms. However the rate of inhibition of MC on the priming activity did not indicate to be in complete proportion to the time period of exposure to the antibiotic, and the assumption described above has not yet been confirmed. Isolation of the tritiated mitomycin C was tried in order to study the possibility whether the antibiotic is bonded to DNA molecule of the cell during the exposure to intact cell. However this trial was found unsuccessful since MC was reduced or somewhat altered in its molecule while it was in contact with tritiated hydrogen gas, resulting in the loss of antibiotic activity. The ^{32}P-labeled deoxyribonucleoside monophosphates were separated from DNA of E. coli cells grown to a limit on ^{32}P-orthophosphate, and phosphorylated chemically to obtain the deoxyribonucleoside triphosphates according to the method described by Hall and Khorana for uridine triphosphate. These compounds will be used for the experiments in the next quarter. (auth)

43170 (EUR-1882.e(p.31-6)) THE BEHAVIOUR OF SPECIFIC NUCLIDES IN THE SOIL, CROPS AND ANIMALS. (Netherlands. Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen).

Cesium penetration and retention was studied in bean leaves. Three hours after treatment approximately 80% of the isotope applied was washed out from primary leaves with 5 ml of water. Cesium concentration in tissues was found related to age and size of the leaf considered, immaterial of that treated. Leaf absorption tests were carried out to determine amounts of ^{134}Cs adsorbed on the treated leaf of bean plants. Trends in adsorption of ^{134}Cs by primary leaves following foliar application are presented. Results from radioautograms of leaf uptake experiments indicated a constant leaf-root distribution of ^{32}P, ^{86}Rb, and ^{134}Cs. Regarding the soil/soil-solution system, it was established that Sr and Ca, on the one hand, and K and Cs on the other, act more or less in the same way. Chlorine was a less suitable analogy for I. A theoretical study of the movement of Sr through soils was carried out, and an attempt was made to find semi-empirical parameters to correlate theoretical assumptions with data obtained on four experimental farms in the Netherlands. The effect of solutions of increasing osmotic pressure on Ca and Sr uptake by oat plants was measured, and no direct relation was found to exist between the uptake of both nuclides and the water uptake as measured by transpiration. A study was made of the influence of extra Ca on ^{90}Sr-excretion in cow's milk, and it appeared that an amount of 500 k Ca per hectare, given to grass, caused a decrease of ^{90}Sr content in milk of about 33%. A study of the possibilities of decontaminating food while it is being treated or processed was initiated. Preliminary experiments were set up to see whether any selectivity in the distribution of cations in pressed juice of grass could be obtained upon addition of different chemical substances. Differences in K, Na, Ca, and Mg were not large enough to allow conclusions as to whether Ca and Sr could be extracted selectively. (H.M.G.)

43171 (LA-3132-MS(p.19-24)) RUTHENIUM-106 IN MICE, RATS, AND DOGS: INTERSPECIFIC COMPARISONS. J. E. Furchner, C. R. Richmond, and G. A. Drake (Los Alamos Scientific Lab., N. Mex.).

Data are presented on the whole-body retention of ^{106}Ru in rats, mice, and dogs after oral and parenteral administration. The relation between body weights and the integrals of the retention functions was determined. (C.H.)

43172 (LA-3132-MS(p.25-31)) THE RETENTION OF MANGANESE-54 BY MICE, RATS, DOGS, AND MONKEYS. J. E. Furchner, G. A. Drake, and C. R. Richmond (Los Alamos Scientific Lab., N. Mex.).

Data are presented on the whole-body retention of ^{54}Mn in dogs, mice, monkeys, and rats. The relation between body weights and the integrals of the retention functions were determined. (C.H.)

43173 (LA-3132-MS(p.32-6)) THE EFFECT OF TEMPERATURE ON THE RETENTION OF RUTHENIUM-106 AND MANGANESE-54 BY MICE. J. E. Furchner, C. R. Richmond, and G. A. Drake (Los Alamos Scientific Lab., N. Mex.).

Environmental temperature had no effect on the excretion of ^{106}Ru and ^{54}Mn by mice. (C.H.)

43174 (LA-3132-MS(p.37-41)) THE LACK OF EFFECT OF WATER LOADING ON THE RETENTION OF CESIUM-137 BY RATS. J. E. Furchner, G. A. Drake, and C. R. Richmond (Los Alamos Scientific Lab., N. Mex.).

Enforced water intake had no effect on the excretion of ^{137}Cs by rats. (C.H.)

43175 (LA-3132-MS(p.42-8)) SIMULTANEOUS MEASUREMENT OF GAMMA-EMITTING RADIONUCLIDES BY LIQUID SCINTILLATION COUNTERS. I. WHOLE-BODY RETENTION OF STRONTIUM-85 AND ZINC-65 BY RATS. C. R. Richmond, J. E. London, and J. E. Furchner (Los Alamos Scientific Lab., N. Mex.).

Results are reported from simultaneous measurements of γ radiation from injected ^{85}Sr and ^{65}Zn in rats using liquid scintillation counters. Comparisons were made of metabolic parameters obtained from a single dose of ^{65}Zn or ^{85}Sr with those obtained from doses of both tracers together. (C.H.)

43176 (LA-3132-MS(p.49-58)) EFFECT OF SPECIFIC ACTIVITY ON STABLE CESIUM TURNOVER BY MAN: STUDIES WITH CESIUM-132 AND CESIUM-137. C. R. Richmond, J. E. London, J. S. Findlay, and J. E. Furchner (Los Alamos Scientific Lab., N. Mex.).

The biological half life of low-specific-activity ^{132}Cs was found to be 50 to 123 days, with a mean of 78 days, in man. The biological half life was considerably larger (152 days) when carrier-free ^{137}Cs was used as a tracer. An estimate was made of retention kinetics of stable ^{133}Cs based on ^{132}Cs and ^{137}Cs tracer studies in the same subjects. (C.H.)

43177 (LA-3132-MS(p.59-65)) EFFECTIVE RETENTION OF PARENTERALLY ADMINISTERED CARRIER-FREE BERYLLIUM-7 BY MICE: COMPARISON OF INTRAPERITONEAL AND INTRAVENOUS ADMINISTRATIONS. C. R. Richmond, J. E. London, and J. E. Furchner (Los Alamos Scientific Lab., N. Mex.).

Data are presented on the whole-body effective retention of parenterally administered carrier-free ^{7}Be by adult female mice. Intravenous and intraperitoneal methods of administration were compared. The biological half lives were found to be 1319 and 1160 days for intravenous and intraperitoneal routes, respectively. (C.H.)

43178 (LA-3132-MS(p.66-75)) WHOLE-BODY RETENTION OF ORALLY AND INTRAVENOUSLY ADMINISTERED BERYLLIUM-7 BY BEAGLES. C. R. Richmond, J. E. London, G. A. Drake, and J. E. Furchner (Los Alamos Scientific Lab., N. Mex.).

Data are presented on the whole-body retention of carrier-free ^{7}Be by adult beagle dogs following oral and intravenous administrations. A relatively large initial uptake and a long effective half life (~52 days) were observed. The equilibrium factor was estimated to be about 33 times the daily intake, and derived biological half lives were on the order of 1300 days. (C.H.)

43179 (LA-3132-MS(p.84-92)) COMPARATIVE METABOLIC DATA FOR MACACA MULATTA AND MACACA SPECIOSA MONKEYS. C. R. Richmond, J. E. London, and J. E. Furchner (Los Alamos Scientific Lab., N. Mex.).

Metabolism of ^{22}Na and ^{131}I was compared in Macaca mulatta and Macaca speciosa monkeys. Similar biological half lives (25 and 26 days) of carrier-free ^{22}Na were observed under similar environmental and dietary conditions. A real difference in ^{131}I metabolism (biological half lives of 55 and 81 days) appeared to exist between the two species of monkeys. M. speciosa appeared to show a higher thyroidal uptake, accompanied by a longer turnover time, as compared with M. mulatta. (C.H.)

43180 (LA-3132-MS(p.93-9)) RETENTION OF SILVER-110 BY RATS AFTER ORAL, INTRAPERITONEAL, AND INTRAVENOUS ADMINISTRATION. J. E. Furchner, G. A. Drake, and C. R. Richmond (Los Alamos Scientific Lab., N. Mex.).

The whole-body retention of ^{110}Ag by rats was measured after oral, intraperitoneal, and intravenous administration. Data are presented for time intervals up to 160 days. (C.H.)

43181 (LA-3132-MS(p.213-17)) REPLICATION OF MENGOVIRUS IN CHINESE HAMSTER OVARY CELLS. R. A. Tobey and E. W. Campbell (Los Alamos Scientific Lab., N. Mex.).

Nontumorigenic Chinese hamster ovary (CHO) cells, which remained nominally diploid during cultivation over 8 years and which possess an extremely short generation time in standard tissue culture media, were shown to act as a host for the RNA virus, Mengovirus. Infection of CHO cells with Mengovirus provided a system for investigating virus-induced processes in a normal cell line. Comparisons were made with mouse L cells. (C.H.)

43182 (LA-3132-MS(p.224-8)) THE ENERGY METABOLISM OF SYNCHRONIZED CELLS. C. T. Gregg (Los Alamos Scientific Lab., N. Mex.).

Studies were made of the respiratory properties of random cell cultures of both hamster ovary and L cells with two objectives: first, to establish base line behavior as a necessary preliminary to study of synchronized cultures; second, to determine whether or not one cell line is more suitable for further study than the others. (C.H.)

43183 (MIT-952-1(p.113-49)) DIFFERENTIAL UPTAKE OF ELEMENTS 88 AND 90 FOLLOWING ORAL INGESTION BY HUMAN BEINGS. (Massachusetts Inst. of Tech., Cambridge. Radioactivity Center).

Preliminary results are reported from studies on the metabolism of ^{224}Ra from mock dial paint administered orally to dogs, and the metabolism of intravenously injected ^{234}Th and ^{224}Ra in humans. Counting methods used are described and excretion and tissue distribution data are tabulated. (C.H.)

43184 (MIT-952-1(p.150-62)) GENERAL RADIOBIOLOGY. (Massachusetts Inst. of Tech., Cambridge. Radioactivity Center).

Routine weekly measurements of the ^{137}Cs body burdens of 6 normal human subjects showed an increase to 6 to 7 times that of the winter of 1961 and 1962. The data indicated that the relative changes with time were the same for

all 6 individuals. Data from whole-body γ counts of individuals given a tracer injection of ^{132}Cs were analyzed with a computer FRANTIC program. The results confirmed a two-component excretion curve and revealed a 57-day biological half life for the major component. A procedure is discussed for determination of changes in the Ca density of bone using neutron activation techniques. Neutron activation was also used for the assay of minute quantities of vitallium alloy in the lymph node of mice. The node was fixed in formaldehyde and transferred to a polyethylene vial filled with distilled water, irradiated for 24 hr and transferred back to formaldehyde soon after irradiation. Sections made from the sample showed little interior damage although the exterior of the sample had deteriorated. The sections were used for the preparation of autoradiograms. Results are reported from whole-body γ counting of individuals for ^{137}Cs, ^{186}Re, ^{195}Pt, ^{226}Ra, and ^{210}Pb. (C.H.)

43185 (ORNL-P-422) NUCLEIC ACID SYNTHESIS DURING GERMINATION AND POSTGERMINATIVE DEVELOPMENT. J. E. Donnellan, Jr. (Oak Ridge National Lab., Tenn.); E. H. Nags, and H. S. Levinson (Army Natick Labs., Natick, Mass.). [1964]. Contract W-7405-eng-26. 18p. (CONF-723-1)

From 3rd Spore Conference, Allerton Park, Ill., Oct. 1964.

The types of nucleic acid synthesized during bacterial spore germination and postgerminative development were studied in spores of Bacillus subtilis using $^{32}PO_4$ as a tracer. Results indicated that the synthesis of DNA is delayed for about 120 min at the start of germination and postgerminative development, while the synthesis of ribosomal RNA commences immediately. The relative amounts of ribosomal RNA and transfer RNA in the elution patterns were used to determine the ratio of the two types of RNA during germination and postgermination development. It was concluded that a differential synthesis of nucleic acids occurs during germination and postgerminative development of bacterial spores. (C.H.)

43186 (ORNL-P-490) RNA SYNTHESIS AND ENZYME INDUCTION BY HYDROCORTISONE. F. T. Kenney, D. L. Greenman, W. D. Wicks, and W. L. Albritton (Oak Ridge National Lab., Tenn.). [1964]. Contract [W-7405-eng-26]. 19p. (CONF-725-1)

From 3rd International Symposium on Regulation of Enzyme Activity and Synthesis in Normal and Neoplastic Tissues, Indianapolis, Ind., Oct. 1964.

Fractionation and characterization of the pulse-labeled RNA from livers of rats treated with hydrocortisone demonstrates that the hormone increases the synthesis of ribosomal and transfer RNA as well as a DNA-like RNA. The hormone did not affect the rate of labeling of transfer RNA due to turnover of the -pCpCpA terminus of the polynucleotide chain. Labeling of acid-soluble nucleotides (AMP) was similarly unaffected. The general nature of the hormone effect on RNA synthesis suggests that enzyme induction may simply reflect a general increase in hepatic protein synthesis. The rapidly turning over enzymes tyrosine transaminase and tryptophan pyrrolase can be induced to a limited extent by ethanol in a steroid-independent and actinomycin-sensitive fashion. (auth)

43187 (TID-19605) THE USE OF FINE-RESOLUTION AUTORADIOGRAPHY IN NEUROLOGICAL AND PSYCHOBIOLOGICAL RESEARCH. Joseph Altman (Massachusetts Inst. of Tech., Cambridge). [1963]. Contract AT(30-1)-906. 28p.

Techniques are described for applications of fine-resolution autoradiography in studies of neural organization and function in the brains of chicks, pigeons, rats, and cats. High specific activity ^{3}H-thymidine was used as a specific DNA precursor, ^{3}H-adenine was used as a nonspecific DNA and RNA precursor, ^{3}H-uracil was used as a specific RNA precursor, and ^{3}H-glycine and ^{3}H-leucine were used as nonspecific protein precursors in studies of regional nucleic acid and protein metabolism under normal and pathological brain conditions and variations in the physiological state of the animal. Procedures used in the preparation of the autoradiograms of brain tissues are described in detail. Microdensitometry was used in place of grain counting. Observations on the structural and functional organization of the nervous system are reported. (35 references.) (C.H.)

43188 (TID-21200) PROGRESS REPORT ON THE USE OF ELEMENT PAIRS IN ELUCIDATING CERTAIN METABOLIC PROCESSES. W. E. Ham (General Electric Co. Hanford Atomic Products Operation, Richland, Wash. and Washington State Univ., Pullman). Aug. 28, 1964. Contract AT(45-1)-1541. 15p.

Progress is reported in studies on the metabolism of Zn and Cd and the interrelationship between dietary Zn and Cd in rats. No obvious interaction between ^{65}Zn and ^{105}Cd transfer across duodenal sacs and Visking membranes were observed and the addition of metabolic inhibitors did not influence the transfer of ^{65}Zn across everted duodenal sacs. The addition of 25, 50 and 75 ppm of Cd to the basal diet of growing rats resulted in diminished weight gain and food consumption as the dietary level of Cd increased while the Zn content of liver and pancreas increase and the Cd content of the small intestine decreased. Data are included on the effect of dietary Zn and Cd on the tissue distribution of ^{65}Zn and ^{115}Cd in rat tissues. (C.H.)

43189 KINETICS OF DISTRIBUTION OF RADIOACTIVE-LABELED MUSCLE RELAXANTS. II. EFFECTS OF RENAL VESSEL OR URETERAL LIGATION ON THE DISTRIBUTION OF C^{14}-DIMETHYL-D-TUBOCURARINE CHLORIDE IN DOGS. G. Dal Santo and W. Petrilli (Metropolitan Hospital, Detroit). Acta Isotopica, 3: 331-48(1963).

The distribution and elimination of ^{14}C-dimethyl-d-tubocurarine following intravenous administration to four dogs, two with complete bilateral renal vessel ligation, the third with unilateral renal vessel ligation, and the fourth with bilateral ureteral ligation, were found altered. The pattern was characterized by: slowed disappearance from the plasma; severely impaired urinary elimination; remarkable and persistent accumulation in the extravascular space; and increased passage into the C.S.F. This picture duplicated the findings observed during hemorrhagic shock, hypoxia, hypercapnia, arterial hypotension, and surface hypothermia. No significant alterations of the kinetics of ^{14}C-dimethyl-d-tubocurarine were found in one dog in which a unilateral ligation of the upper third of the ureter was performed. The data are discussed and an explanation for the increased passage into the C.S.F. is presented. (auth)

43190 STUDIES ON ZINC METABOLISM. II. KINETICS OF Zn^{65} IN THE ORGANS OF NORMAL RABBITS. N. Conte and C. Scandellari (Università, Padua). Acta Isotopica, 3: 367-75(1963).

The uptake of ^{65}Zn was investigated in some organs of the normal rabbit, following intravenous injection of a tracer dose of ^{65}Zn. The results suggest that some organs (kidney, liver, spleen, pancreas) have an accelerated turnover of radiozinc, whereas another group of organs (lungs, stomach, myocardium, skeletal muscle) have a slower one.

This differential uptake is thought to cause the two components of the curve of ^{65}Zn in plasma. (auth)

43191 EFFECTS OF THYROIDECTOMY UPON I^{131} UPTAKE BY THE SUBMAXILLARY GLANDS IN A_2G MICE. Francisca R. Alberti, M. Siatopolsky Cantis, and A. B. Houssay (Universidad, Buenos Aires). Acta Physiol. Latinoam., 14: 5-11(1964).

In thyroidectomized male mice there is a significant decrease of ^{131}I concentration by the submaxillaries. In two out of five experiments there is a decrease in ^{131}I concentration by the retrolinguals and parotids. In thyroidectomized female mice there are no changes in ^{131}I concentration by any of the salivary glands. The daily administration of 1 μg triiodothyronine during 68 days increased ^{131}I concentration by the submaxillaries of thyroidectomized male mice. No effect was seen with smaller doses. The possible relation between the action of thyroidectomy upon the structure of the serous tubules and upon ^{131}I uptake by the submaxillaries is discussed. (auth)

43192 APPLICATION OF NUCLEAR MAGNETIC RESONANCE IN BIOCHEMISTRY. Arthur Kowalsky and Mildred Cohn (Univ. of Pennsylvania, Philadelphia). Ann. Rev. Biochem., 33: 481-518(1964).

Applications of nuclear magnetic resonance in biochemistry are reviewed. It is pointed out that, in a review of a technique which is based on a phenomenon that has only recently become observable and in which technical advances and development of new experimental techniques are progressing so rapidly, it is inevitable that future possibilities are given undue emphasis compared to the not inconsiderable solid accomplishments. In some areas the potentialities inherent in nuclear magnetic resonance spectroscopy have been fully realized but many other areas must await suitable theoretical clarification and development in instrumentation to achieve fruition. (auth)

43193 GAMMA SPECTROMETRIC AND FLAME PHOTOMETRIC INVESTIGATION OF POTASSIUM CONTENT AND DISTRIBUTION IN THE HUMAN BODY. A. Kaul, W. Schoeppe, K. M. Koch, and K. Hierholzer (Max-Planck-Institut für Biophysik, Frankfurt am Main and Universität, Frankfurt am Main). Biophysik, 2: 87-104(1964). (In German)

The total-body potassium content was measured in healthy persons by gamma spectrometry of the ^{40}K isotope contained in natural potassium. The mean value of GK_K was 1.68 g K/kg in men and 1.51 g K/kg in women with a fluctuation range ≤ ±15% (n = 92). The K concentration measured by flame photometry in the plasma of normal persons was 4.03 meq/l ± 0.26, and the simultaneously measured potassium content in erythrocyte sediment was 90.9 meq/l sediment ± 2.6 (n = 57). The three potassium parameters were measured simultaneously in healthy individuals and variation of these magnitudes in experimental potassium deficiency caused by salt uretics was followed. In a research period of 7 days, the total-body potassium content decreased during administration of chlorthalidon (2 × 100 mg/day) on an average of 7.7% and the potassium concentration in plasma or erythrocytes by 27.5 and 3.1%, respectively. Erythrocytes represent, under the research conditions selected, a cell system that indicates the qualitative change of the potassium concentration of the intracellular space. The extent of the potassium loss is, however, larger in other cell systems as can be proven on the basis of the determination of the total-body potassium content. The significance of the determination of various potassium parameters in men for the clinical evaluation of pathological states was discussed. (tr-auth)

43194 IN VITRO EFFECTS OF THYROTROPIC HORMONE. II. ON UPTAKE AND INCORPORATION OF ^{131}I INTO IODOAMINO ACIDS BY ISOLATED THYROID CELLS IN MONOLAYER CULTURES. Paul R. Kerkof, E. Raghupathy, and I. L. Chaikoff (Univ. of California, Berkeley). Endocrinology, 75: 537-46(Oct. 1964).

Sheep thyroid gland cells isolated by a continuous-flow, trypsinization procedure were cultured as monolayers. The utilization of ^{131}I-iodide by such cultures was studied from 1 to 7 days in the presence and absence of TSH. The ^{131}I uptake and its incorporation into each iodoamino acid (MIT, DIT and T_4) decreased after the first day in culture. Addition of TSH at the start of culturing consistently enhanced the ^{131}I uptake and its incorporation into iodoamino acids from the 3rd to 7th days of culture. By the 7th day, the ^{131}I recovered as MIT, DIT, and T_4 in the cells of TSH-treated cultures was 260, 660, and 520%, respectively, of the control values. Only MIT and DIT were present in the protein-bound ^{131}I of the medium. The amounts of these iodoamino acids did not increase with time in either control or TSH-treated cultures. $^{131}I-T_4$ was recovered in the free form from the incubation medium, and its amount increased with time in the TSH-treated cultures. Fractionation of cells from 3-day cultures revealed that 40 to 60% of the ^{131}I was in the soluble fraction. Addition of TSH to the cultures increased the ^{131}I content of this fraction by 330%. Of the ^{131}I recovered as iodoamino acids in the cells, 40 and 70% were found in the soluble fraction of control and TSH-treated cells, respectively. (auth)

43195 EFFECT OF INJECTED THYROTROPIC HORMONE ON THE IN VITRO UPTAKE AND METABOLISM OF ^{131}I BY THYROID GLANDS OF FETAL AND NEWBORN RATS. B. M. Nataf and I. L. Chaikoff (Univ. of California, Berkeley). Endocrinology, 75: 547-53(Oct. 1964).

Intact thyroid gland lobes of fetal, newborn, and adult rats, and slices prepared from glands of adult rats, all of which had been injected with identical doses of thyrotropic hormone (TSH) in relation to body weight, were incubated in a Ringer-bicarbonate medium containing ^{131}I, and their incorporation of the labeled iodine into iodoamino acids was compared. A distinct difference between the ^{131}I metabolism of the intact lobe and slices of the adult rat thyroid gland was observed. This consisted of a greater uptake of the added ^{131}I and its incorporation into diiodotyrosine (DIT) by the lobes. The finding that early after a TSH injection the ^{131}I uptake by the incubated intact thyroid lobe of adult rat is diminished is confirmed. This was not observed in the experiments with slices. Under identical hormone treatments, the incubated thyroid glands of fetuses and newborn rats were much more responsive to injected TSH than were those of adult rats. A dual action of TSH on ^{131}I metabolism by the incubated thyroid lobe of fetuses and newborn rats was found: an initial one (30 min to 5 hr) in which only the disposition of the tissue's ^{131}I was affected; and a later action (19 to 24 hr) in which uptake as well as internal disposition was involved. (auth)

43196 QUALITATIVE CHANGES IN THYROID GLAND SECRETION FOLLOWING THYROID HORMONE ADMINISTRATION. J. M. McKenzie (McGill Univ., Montreal). Endocrinology, 75: 554-60(Oct. 1964).

The ratio of fecal to total excreted (fecal and urinary) radioiodine (F/T) was studied in mice with thyroid iodine labeled with ^{131}I, and in those injected with ^{131}I-labeled thyroxine, triiodothyronine, monoiodotyrosine, diiodotyrosine, or iodide. In the case of thyroid secretion of labeled components it was found that thyroid added to the diet or thyroid hormone injected led to the expected decrease in total ^{131}I

excretion, but in addition there was a fall in F/T from 0.5 to 0.2. Administration of thyroid did not appreciably affect the pattern of excretion of injected radiothyroxine (0.6) and triiodothyronine (0.5). The substituted tyrosines and iodide all gave an F/T of about 0.05. In vitro deiodinating activity (for ^{131}I-diiodotyrosine) of the suppressed glands was markedly reduced in comparison with the activity of normal glands. It was postulated that this allowed the secretion of iodinated tyrosines, as well as thyronines, from the suppressed thyroid gland in vivo, which would account for the observed fall in F/T. (auth)

43197 PERMEABILITY OF UNINJURED SKIN TO RADIOACTIVE PHOSPHORUS AND CALCIUM UNDER THE EFFECT OF GALVANIC CURRENT. V. R. Feitelberg-Blank (Ukrainian Inst. of Scientific Research in Physiotherapy, Odessa). Fiziol. Zh., Akad. Nauk Ukr. RSR, 9: 247-50(1963). (In Ukrainian)

The permeability of the uninjured skin of rabbits with respect to ^{32}P and ^{45}Ca was measured with an applied galvanic current at current densities of 0.1, 0.2, and 0.5 ma/cm^2 and without current. In some of the tests the area tested was increased by a factor of 2; the ionic concentration was also similarly varied and in parallel tests, the direction of the current was reversed. It was found that aqueous solutions of $Na_2H^{32}PO_4$ passed through the uninjured skin into the organism. Application of the current resulted in an increase of the permeability of the skin for radiophosphorus, especially after the current was stopped. This increase of the permeability is probably due to the formation of chemically active compounds which affect the cell elements. The highest penetrability was obtained at a current density of 0.2 ma/cm^2. Increase of the surface and of the ion concentration per unit surface tended to cause a similar increase in the permeability of the skin, especially when the current was applied. Similar tests were performed with $^{45}CaCl_2$ in solutions with activities of 22.5, 50, and 100 μcurie. The ^{45}Ca did not pass through the uninjured skin, regardless of the current applied. (TTT)

43198 ENVIRONMENTAL IODINE-131 IN THYROIDS OF CHILDREN AND ADULTS—RECENT POST MORTEM AND WHOLE BODY COUNTER MEASUREMENTS. George W. Gaffney and Raymond T. Moore (Public Health Service, Washington, D. C.). Health Phys., 10: 715-29(Oct. 1964).

^{131}I was collected and determined in more than 1300 human thyroid glands made available from autopsies since the fall of 1961 through arrangements with the Armed Forces Institute of Pathology and a number of medical centers throughout the country. Some results from this activity are reviewed. Several pilot-scale feasibility studies were conducted in children and pregnant women involving in vivo measurement of thyroidal burdens of ^{131}I from fallout, and attempts were made to relate the measured burdens to intake. Comparison was made of measured burdens with those calculated from intake using available models, granting certain assumptions and information on intake of the radionuclide. In one feasibility study in ten children 1 to 6 years old, the ^{131}I in their thyroids as determined by external monitoring was found to be lower by about a factor of 2 than the calculated accumulation of ^{131}I based on a commonly used exponential model, assuming 30% thyroidal uptake and a 7.6 day effective half life. The limited data obtained in the feasibility studies appeared to support the contention that the vehicle of intake of ^{131}I from fallout was fresh foods, principally milk. It was demonstrated that, under appropriate conditions involving use of a suitable facility, 20-min measurements of ^{131}I in the thyroid in human subjects as young as 4 years of age may be made repeatedly without sedation or restraint. (auth)

43199 THE SOURCE OF UNSUPPORTED Po^{210}(RaF) IN TISSUE. Richard B. Holtzman (Argonne National Lab., Ill.). Health Phys., 10: 763-4(Oct. 1964).

The metabolism of ^{210}Po in man is reviewed and the effects of dietary variations in ^{210}Po on estimations of the whole-body content are reviewed. It is postulated that data on the ^{210}Pb content, which is easier to measure and more meaningful on a long-term basis, may be used to estimate the ^{210}Pb–^{210}Po dose in man. (C.H.)

43200 SOME SUGGESTED MAXIMUM PERMISSIBLE SINGLE INTAKES OF URANIUM. I. S. Eve (United Kingdom Atomic Energy Authority, Harwell, Berks, Eng.). Health Phys., 10: 773-6(Nov. 1964).

The Recommendations of the International Commission on Radiological Protection (1959) give maximum permissible concentrations for uranium in air and water, but before the issue of ICRP Publication 6 in 1964, there were no instructions concerning the time over which MPC's based on chemical toxicity of uranium might be averaged. The present paper, which was circulated informally in the U.K. Atomic Energy Authority before the issue of ICRP Publication 6, makes some suggestions regarding maximum angle intakes of natural uranium under various circumstances. These are: maximum single intake of inhaled uranium in 1 day, 2.5 mg; maximum single intake of ingested uranium in 1 day, 150 mg; and maximum planned emergency inhalation for occupationally-exposed persons, 10 mg. The first two of these suggestions are now in line with the recommendations of ICRP Publication 6. (auth)

43201 FISSION PRODUCT METABOLISM IN HENS AND TRANSFERENCE TO EGGS. F. R. Mraz, P. L. Wright, T. M. Ferguson, and D. L. Anderson (Univ. of Tenn., Oak Ridge). Health Phys., 10: 777-82(Nov. 1964).

Groups of eight laying Single-Comb White Leghorn pullets were each administered the following fission products: strontium-89, yttrium-91, niobium-95, molybdenum-99, ruthenium-103, iodine-131, tellerium-132, cesium-134, barium-140, lanthanum-140, praseodymium-142, cerium-144, neodymium-147 or promethium-147 at levels selected to permit counting of tissues upon sacrifice 96 hr after dosing. Half the hens were administered the fission products intramuscularly (IM) while the other half received them orally. Whole blood, plasma, gastrocnemius muscle, superficial pectoralis muscle, liver, gall-bladder, kidney, lung, spleen, heart, brain, gizzard, tibia shaft, posterior portion of sternal crest, ovary, reproductive tract, and eggs were analyzed for fission product content. The differences in fission product concentration in tissues and egg components between IM and oral routes were quite small for ^{134}Cs, ^{89}Sr, and ^{131}I. These same differences for the fission products increased in magnitude in the following order: ^{99}Mo, ^{140}Ba, ^{132}Te, ^{142}Pr, and ^{103}Ru. Very little, if any, ^{91}Y, ^{95}Nb, ^{140}La, ^{144}Ce, ^{147}Nd, or ^{147}Pm was found in the tissues and eggs from hens receiving these fission products orally. The fission products of cesium, tellurium, lanthanum, neodymium and molybdenum in poultry meat and iodine, cesium, tellurium, molybdenum, barium, and strontium in eggs might be potential hazards to man consuming these from hens which ingested these fission products. This list would be extended if a parenteral contamination of poultry occurred. (auth)

43202 INCORPORATION OF RADIOIRON INTO MARROW HEME. Ward D. Noyes, Fazle Hosain, and Clement

A. Finch (Univ. of Washington, Seattle). J. Lab. Clin. Med., 64: 574-80(Oct. 1964).

The amount of iron assimilated by the marrow and the time required for its incorporation into hemoglobin in vivo was studied in the rabbit. Approximately 80 per cent of transferrin-bound ^{59}Fe was localized within the skeleton, and approximately 80 per cent of this iron was incorporated into hemoglobin within 1 hour. Additional studies of hemoglobin versus nonhemoglobin iron in rats, dogs, and in man indicated a similarly rapid and complete process of heme synthesis. It is concluded that there is no preheme pool of appreciable size involved in normal erythropoiesis in these species. (auth)

43203 A FIFTEEN-MINUTE TEST OF THE RATE OF THYROID TRAPPING OF RADIO-IODINE. Leonard Rosenthall (Montreal General Hospital). J. Nucl. Med., 5: 657-63(Sept. 1964).

A simple 15 minute thyroid function test is described. Continuous recording of radioiodine activity over the thyroid gland following intravenous injection is obtained, and the ratio of the count rate at 15 minutes to 5 minutes is estimated (R_{15}). The relationship of R_{15} to the 24 hour uptake (T_{24}) is given by $\log R_{15} = 0.292 \log T_{24} - 0.334$, with a 0.87 coefficient of correlation. The value of R_{15} is independent of the administered dose and insensitive to small changes in crystal-skin distance. In 310 clinically evaluated patients the trapping rate index was found to be more sensitive in separating hyperthyroidism from euthyroidism than the conventional 24 hour uptake. The R_{15} and T_{24} were about equally efficient in distinguishing euthyroidism from hypothyroidism. TSH stimulation and T3 suppression can be readily determined and a greater insight into the pathophysiology of the thyroid disorder can be obtained by using this simple 15 minute test. (auth)

43204 RETENTION OF RADIOISOTOPES BY HAIR, BONE AND VASCULAR TISSUE. William H. Strain (Univ. of Rochester, N. Y.), William P. Berliner, Charles A. Lankau, Jr., Richard K. McEvoy, Walter J. Pories, and Robert H. Greenlaw. J. Nucl. Med., 5: 664-74(Sept. 1964).

Comparative studies were made on the retention of intravenously administered ^{48}V and ^{65}Zn by blood, liver, femur, hair, and aorta in young and old rats of both sexes over a period of twenty days. Although it is extremely low, the vanadium-48 hair retention pattern generally reflects the accumulation of the radioisotope by the other tissues examined, except blood. Zinc-65 retention in hair continues to build up with the passage of time and appears to correlate only with the femur radioactivity. Age and sex are shown to be important variables in the retention of the two isotopes. (auth)

43205 STUDIES OF IN VITRO INCORPORATION OF P^{32} BY HUMAN ERYTHROCYTES. James T. Custod, Joseph Bernsohn, and Alexander P. Remenchik (Loyola Univ., Chicago and Veterans Administration Hospital, Hines, Ill.). J. Nucl. Med., 5: 681-90(Sept. 1964).

For optimal ^{32}P uptake, the ratio of blood to beaker volume is critical, and should be about 1:10. Increasing the shaking rate of a blood sample incubated in a non-optimal beaker size, increases the ^{32}P uptake. Incubation of erythrocytes in a saline medium containing ^{32}P produces a significant increase in ^{32}P uptake when compared to the uptake in a plasma medium. As the concentration of inorganic phosphate is increased in a saline medium containing erythrocytes, the ^{32}P uptake by the cells is decreased. No appreciable differences in ^{32}P uptake were noted when the following experiments were performed: anaerobic vs aerobic incubation; heparin levels (0.05 mg/ml blood to 1.00 mg/ml blood); paraffin-coated beaker vs. glass beaker; and subjecting red cells to centrifugational speeds of 270 xg and 7,710 xg prior to incubation with ^{32}P. (auth)

43206 EXPERIMENTAL STUDIES OF THE EMISSION OF RADIOACTIVE COLLOIDAL Au^{198}, $Na_2HP^{32}O_4$, $Na^{24}Cl$ AND NaI^{131} THROUGH THE ARACHNOIDAL MEMBRANE. M. A. Baron, F. M. Lyass, and N. A. Maioriva (Inst. of Neurosurgery, Academy of Medical Science, USSR). Med. Radiol., 9: No. 8, 60-70(Aug. 1964). (In Russian)

The present investigation was undertaken to assess the emission of different radioactive isotopes through the arachnoid membrane. For this purpose a new method of radiological investigation was elaborated, which made it possible to study experimentally the fate of the radioactive isotope introduced into the cerebellomedullary cistern. (auth)

43207 PATHOGENESIS OF BONE-MARROW FAILURE IN THE AUTO-IMMUNE ERYTHROBLASTIC APLASIA. E. Bianchini and V. Rossi (Universita, Genoa). Nucl. Hematol., 3: IV-V(Sept.-Nov. 1964).

Ferrokinetics studies, using ^{59}Fe in a case of erythroblastic aplasia in course of auto-immune hemolytic anemia, showed a marked rise of erythrocytic radioiron utilization at the twelfth day, after prednisone treatment, associated with the erythroblastic repopulation of the bone-marrow. Such behavior allows the statement that the erythroblastic aplasia during auto-immune hemolytic anemia is probably due to a damage to the stem cells department, and to an erythroblastic maturation arrest. (auth)

43208 ACATALASEMIC MICE. Robert N. Feinstein, John E. Seaholm, Judith B. Howard, and W. L. Russell (Argonne National Lab., Ill. and Oak Ridge National Lab., Tenn.). Proc. Natl. Acad. Sci. U. S., 52: 661-2(Sept. 1964). (ORNL-P-207)

The production of genetically acatalasemic mice is reported. Two animals proved by breeding tests to be mutants were a female of blood catalase 40 PU/ml and a male of blood catalase 92 PU/ml were mated and produced a son with the low blood catalase of 14 PU/ml. Backcrossing this male to his dam produced a litter of seven with the following blood catalase levels: 1.3, 2.2, 9.6, 61, 78, 87, and 89.PU/ml. The demonstrated feasibility of obtaining mutants that provide the material for the study of various inborn errors of metabolism is emphasized. The requirements are a large supply of progeny of irradiated animals, and a rapid blood screening test capable of distinguishing merely between normal and abnormal blood levels of the relevant constituent. (P.C.H.)

43209 DNA IN MITOCHONDRIA OF NEUROSPORA CRASSA. David J. L. Luck and Edward Reich (Rockefeller Inst., New York). Proc. Natl. Acad. Sci. U. S., 52: 931-8 (Oct. 1964).

A DNA of unique buoyant density and a nucleotide-incorporating activity resembling DNA-dependent RNA polymerase were found to be present in mitochondrial fractions of Neurospora crassa. These components appeared to be effectively segregated in the intact mitochondrion from externally added DNase, RNase, and DNA. (auth)

43210 THE NATURAL RADIOACTIVITY OF THE HUMAN BODY. W. V. Mayneord (Royal Cancer Hospital, London). Progr. Biophys. Biophys. Chem., 11: 1-24(1961).

Natural radioactivity of the human body arises from the presence of very small quantities of natural U, Th, and other actinides, together with ^{40}K and very small quantities

of ^{14}C and ^{3}H. This activity is incorporated into the embryo, built up in the fetus, and continually renewed and dissipated in the metabolic processes of the adult organism. It is pointed out that the evolution of man has occurred in the presence of levels of radioactivity at least comparable with, and sometimes much greater than, those arising from modern nuclear developments. The origin and metabolism of radioactive trace elements in humans during normal and abnormal metabolic conditions are discussed. Simple procedures are described for estimating total α activity in biological samples. Data are summarized from the analysis of several thousand specimens ranging from human tissues, both bone and soft tissues, human excreta, animal tissues plant material, and samples of soils, waters, gases, foods, and other environmental materials. An attempt is made to define the origin of normal radioactivity of man and to estimate the fraction of ingested radioactivity that is retained in bone and soft tissues. Measurements made on the rib of an Egyptian who died approximately 4000 years ago indicate that the natural α-activity of human bone some 4000 years ago was approximately that found at present. (C.H.)

43211 RELAZIONI TENUTE AL SIMPOSIO SU: L'USO DEGLI ISOTOPI RADIOATTIVI IN BIOLOGIA MARINA, 15-18 SEPTEMBRE 1957, NAPLES. (Lectures Held at the Symposium on Marine Biological Applications of Radioisotope Research Techniques, September 15-18, 1957, Naples). Pubbl. Staz. Zool. Napoli, 31: Suppl., 1-189(1959).

A symposium on Marine Biological Applications of Radioisotope Research Techniques was held on Sept. 15 to 28th, 1957, at the Zoological Station of Naples, Italy. Eleven lectures covered instrumentation for marine biological research, radiochemical techniques, the distribution of radioisotopes among marine organisms in the Pacific Ocean, radioactive tracing of the movement of an essential element through an aquatic community, the ^{14}C technique for determination of plankton primary productivity, the incorporation of radioactive compounds in Echinoderm eggs, autoradiographic techniques, the use of tritium and other radioisotopes in studies of the foods and feeding activities of marine animals, and iodine metabolism in marine animals. (C.H.)

43212 LABELLING OF M. TUBERCULOSIS WITH RADIOISOTOPES PHOSPHORUS ^{32}P OR SULPHUR ^{35}S ON SOLID MEDIA WITH CELLOPHANE. J. Kuška, L. Trnka, and R. Urbančík. Rozhledy Tuberk., 24: 78-80(1964).

A simple method of labelling M. tuberculosis with ^{32}P or ^{35}S on solid agar medium with cellophane discs is described. A culture of M. tuberculosis was inoculated on sterile cellophane discs in the form of circles or part-circles, which were afterwards bedded in a suitable arrangement on the surface of active agar media. Cultures grown in this fashion could be further processed by, for instance, dialysis or washing through a membrane filter. No statistically significant differences could be found between the incorporation of radioactive phosphorus and sulfur in mycobacteria growing in this medium and mycobacteria growing in the usual Sauton liquid medium. The advantage of the proposed method is the small quantity of medium and radioisotope required. The method also results in shorter contact of the worker with the radioactive material, which contributes to an increased protection against radioactive radiation. (Excerpta Med., Sect. XXIII, 1: (Sept. 1964))

43213 CESIUM BEHAVIOUR AND DISTRIBUTION IN MAN FOLLOWING A SINGLE DOSE OF ^{137}Cs. Kjell Madshus (Norsk Hydros Inst. for Cancer Research, Oslo) and Aksel Stroemme. Z. Naturforsch., 19b: 690-2(Aug. 1964).

The excretion and distribution of ^{137}Cs in a 60 year old male given a single dose of 8.2 μC through a gastrostomy were studied. The excretion rates and the concentrations in feces, urine, and blood are presented, as well as the distribution of ^{137}Cs in several of the internal organs removed after death. The biological half-life for cesium in this study is approximately 100 days. (auth)

43214 THE DEVELOPMENT OF MODERN BIOCHEMISTRY AND THE USE OF RADIOISOTOPES. J. Roche (Collège de France, Paris). p.745-61 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Uses of molecules labeled with radioisotopes in biochemistry are discussed. Studies of thyroidal hormones, the biosynthesis of organism components or of metabolic products, and degradation reactions are described. (M.C.G.)

43215 RADIOACTIVE DRUGS AND THEIR SIGNIFICANCE IN PHARMACOLOGY. R. Paoletti and Maria Poggi (Università, Milan). p.1137-46 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Advantages of the use of labeled drugs in pharmacological research are outlined. Uses of radioisotopes in neuropharmacology are discussed. Tracer studies of a psychoanaleptic drug, 3,3'-pentamethylene-4-butyric acid, are described. (M.C.G.)

Radiation Effects

43216 (BNL-8387) INFLUENCE OF EXTRACORPOREAL IRRADIATION OF THE BLOOD UPON LYMPHOCYTES AND IMMUNITY. E. P. Cronkite, A. D. Chanana, R. S. Stoner, Hp. Schnappauf, H. Cottier, C. R. Jansen, and Kanti R. Rai (Brookhaven National Lab., Upton, N. Y.). Aug. 19, 1964. Contract AT-30-2-GEN-16. 37p. (CONF-717-2)

From CNRS Meeting on Graft of Allogenic Hematopoietic Cells, Paris, Sept. 1964.

Extracorporeal irradiation was developed initially as an adjunct to study the role of lymphocytes in radiation injury and problems concerned with the regulation of lymphocyte production. During the period of development, knowledge of lymphocytes grew and there are now areas in which extracorporeal irradiation is applied both in the study of fundamental physiological phenomena and the possible application in human disease such as homotransplantation of organs, treatment of autoimmune disease, and the treatment of leukemia. (auth)

43217 (COO-1117-6) EFFECTS OF GAMMA RADIATION AND OTHER AGENTS ON MACROMOLECULAR SYNTHESIS AND MITOSIS IN CHLAMYDOMONAS. Baruch S. Jacobson and Theresa C. Lee (Minnesota. Univ., Minneapolis). [1964]. Contract AT(11-1)-1117. 8p. (CONF-556-18).

From 12th Annual Meeting of the Radiation Research Society, Miami, Fla., May 1964.

Chlamydomonas reinhardi is a unicellular green alga with a mitotic cycle characterized by 2 to 3 divisions occurring in rapid succession after several hours of vegetative growth. Postirradiation delayed death is characterized by a colony-size distribution indicating that death occurs at a specific stage in the cell cycle. Similar dis-

tributions are obtained by treatment of unirradiated cells with chloramphenicol or actinomycin D. Both radiation and AMD produce a similar inhibitory effect on overall RNA synthesis, after 12 hours. CM inhibits macromolecular synthesis in general. It is suggested that some critical step, associated with the first mitosis of the series, and involving the transfer of molecular information, is responsible for these effects. (auth)

43218 (EUR-1882.e(p.7-26)) RADIATION-INDUCED CHANGES IN PLANTS. (Netherlands. Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen).

Progress reported on radioinduced mutation breeding includes: studies of chimeras; the induction of point mutations in potatoes; research on beans; the use of artificially induced chromosome translocations in the breeding of Phaseolus vulgaris; significance of micro-mutations in barley and wheat; significance of macro-mutations in barley; diploidization of autotetraploid barley; experimental mutagenesis in Triticum durum; research on peas; comparison of the mutagenic effect of x rays, γ rays, neutrons, and ethylene-methane-sulfonate; investigations about pleiotropy and expressivity of mutated genes; research on tomatoes; and comparison of mutagenic effect of x ray, γ rays, and neutrons on tomatoes. Radiation effects on different ontogenetical stages were studied in gamma-irradiated Nicotiana rustica, N. tabacum, and N. sylvestris. Species variation in radiosensitivity was investigated in Nicotiana and Vicia sativa. Endosperm-embryo relations were determined in x- and fast neutron-irradiated seeds of Triticum durum. (H.M.G.)

43219 (HW-SA-3716) TOXICITY OF COPPER ADMINISTRATION AND X-IRRADIATION IN RATS (thesis). Patricia Lou Hackett (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 15, 1964. Contract AT(45-1)-1350. 107p.

Submitted to Washington State Univ., Pullman.

Results are reported from experiments conducted with 254 adult rats to study the effects of single and combined assaults of whole-body x irradiation and copper. Data are presented on food and water consumption, urine volume, body weight, hematological constituents, and copper concentrations in organs, blood, and urine. (C.H.)

43220 (LA-3132-MS(p.109-41)) STUDIES OF X-IRRADIATED MOUSE POPULATIONS. (Los Alamos Scientific Lab., N. Mex.).

Progress is reported on a large-scale radiation genetics program to determine some of the heritable effects of x radiation in mouse populations. Data are presented on the breeding characteristics of mice from 5, 10, 15, and 20 generations of irradiated sires; the radiosensitivity of mice from 25 generations of irradiated sires; the life span of mice from 5, 10, and 15 generations of irradiated sires; the physiological response of mice of irradiated and normal ancestry to a nontraumatic stress, using a high-frequency, short-duration stroboscopic light source as stimulus; the blood picture and blood chemistry of mice of each genetic and stock group; radioinduced changes in the electrical charge of hemoglobin molecules as demonstrated by electrophoretic analysis of hemoglobin from the blood of mice from the 27th irradiated filial generation; and measurements of physiological capacitance as an index of activity of mice of irradiated and normal ancestry. (C.H.)

43221 (MIT-952-1) RADIUM AND MESOTHORIUM POISONING AND DOSIMETRY AND INSTRUMENTATION TECHNIQUES IN APPLIED RADIOACTIVITY. Annual Progress Report. Robley D. Evans (Massachusetts Inst. of Tech., Cambridge. Radioactivity Center). May 1964. Contract AT(30-1)-952. 323p.

Separate abstracts were prepared on six sections of this report on radium and mesothorium poisoning. (C.H.)

For abstracts of individual papers see: 43183, 43184, 43222, 43802, 43936, and 44732.

43222 (MIT-952-1(p.1-112)) RADIUM AND MESOTHORIUM TOXICITY IN HUMAN BEINGS. (Massachusetts Inst. of Tech., Cambridge. Radioactivity Center).

Data are summarized on 87 individuals exposed to ^{226}Ra or ^{228}Ra. Most of the individuals were exposed while employed as luminous dial painters, from Thorotrast used in radiographic examinations, or while employed in chemical laboratories where Ra was used. Whole-body counting was used to determine the Ra body burden. Measurements were also made of the relative ^{226}Ra specific activities of bone samples and skeletons. Chromosome analysis of blood cells from 18 persons with burdens of ^{226}Ra or ^{228}Ra ranging from less than 0.1 to 1.94 μC showed numerical and structural aberrations. A relation was seen between the number of chromosome abnormalities and body burden. The long-term effects of residence by 17 persons in a house highly contaminated by Ra are reported. Data are presented from a quantitative evaluation of dose-response relations in 361 human beings with skeletal burdens of ^{226}Ra and ^{228}Ra. Data representing 70 items per subject were transferred from IBM cards to magnetic tape, which was used in the calculations of the minimum pure Ra equivalent (MPRE) for each case. Data were tabulated. There were definite indications of nonskeletal effects, particularly in lymphocyte count and sedimentation rate, in individuals with higher Ra body burdens, while no clinically significant signs or symptoms were observed at MPRE below 0.5 μC. Calculations were also made of cumulative Rad and cumulative Rad years at time of death or time of measurement for a number of cases. (C.H.)

43223 (NYO-1727-1) ENZYMATIC AND BIOCHEMICAL STUDIES OF EPIDERMIS WHICH HAVE BEEN IRRADIATED WITH BETA PARTICLES. Final Report, May 14, 1954–August 14, 1964. (Albert Einstein Medical Center, Philadelphia). Contract AT(30-1)-1727. 13p.

Results are summarized from a series of studies of enzymatic and biochemical changes in the epidermis of guinea pigs induced by exposure to a single surface dose of 3000 rep β radiation from a sealed $^{90}Sr-^{90}Y$ source. Radioinduced biochemical changes were diphasic in nature with a first peak 3 days post-irradiation, well before any visible evidence of injury, and a second peak about the 30th day and a return to near normal two months after exposure. The RNA/DNA ratio increased from 1.2 to about 2.0 by the 20th post-irradiation day and returned to near normal by the 60th day. Nineteen free amino acids were quantitatively determined by ion exchange chromatography and measurements were also made of the content of acid soluble constituents, such as urocanic acid, ammonia, and total free amino acids. Histochemical studies revealed alterations characteristic of second degree burns. A single surface dose of 3000 rep β radiation produced a progressive increase in both extracellular and intracellular epidermal ribonuclease activity from the first day to a peak about 3 times the control value by the second week. A significant increase in intracellular desoxyribonuclease I activity was observed 24 hr after irradiation. A 30% decrease in intracellular desoxyribonuclease II activity occurred during the

same period, but no change was observed in the activity of the extracellular enzyme. Evidence is presented for the presence of pyroglutamic acid, or a close derivative, as a major constituent of guinea pig epidermis. A quantitative method for its assay in this tissue is described. (C.H.)

43224 (ORNL-P-346) LACK OF EXPRESSION OF PARENTAL ISOANTIGEN(S) IN F_1 HYBRID MICE. G. Cudkowicz and J. H. Stimpfling (Oak Ridge National Lab., Tenn. and Roscoe B. Jackson Memorial Lab., Bar Harbor, Me.). [Aug. 21, 1964]. Contract W-7405-eng-26. 10p. (CONF-703-2)

From 10th Congress of the International Society of Blood Transfusion, Stockholm, Sept. 1964.

Marrow cells of parental donors failed to grow on transplantation into x irradiated F_1 hybrid recipients if the donors were $\underline{H\text{-}2^b}$ homozygotes and if the recipients were $\underline{H\text{-}2^b}$ heterozygotes. This failure of growth could not be correlated with any other known allele at the H-1, H-2, H-3, or H-4 locus, or with any other aspect of the donor's genetic background. (C3H X C56BL)F_1 hybrids that were made unresponsive toward C57BL marrow grafts by preexposure to C57BL tissue isoantigens were similarly unresponsive, i.e., nonresistant, toward marrow grafts of other $\underline{H\text{-}2^b}/\underline{H\text{-}2^b}$ donors. This indicated that the factor responsible for hybrid resistance to parental marrow was similar in all the $\underline{H\text{-}2^b}/\underline{H\text{-}2^b}$ strains that were investigated. The findings support the interpretation that genetic interaction involving a subunit of H-2 (associated with the K region) results in lack of expression in F_1 heterozygotes of isoantigen(s) of the $\underline{H\text{-}2^b}$ phenotype, affecting the survival of homozygous parental marrow grafts. (auth)

43225 (ORNL-P-388) RECENT DEVELOPMENTS IN RESEARCH ON RADIATION AND CHEMICAL MUTAGEN EFFECTS IN INSECTS. R. C. von Borstel (Oak Ridge National Lab., Tenn.). Aug. 20, 1964. Contract W-7405-eng-26. 9p. (CONF-744-1).

From *Report on Insect Control by Sterile Male Technique* (IAEA) Vienna, July 1964.

Problems encountered in the control of insects by induced sterility of males are discussed. It is pointed out that induced sterility may be due to dominant lethality or true sterility from gonad cell killing or sperm inactivation. When males are irradiated, care must be taken that they are not weakened, as males released in the field must be vigorous to successfully compete. Possible ways to lessen the male-weakening effects of radiation are discussed. Recent advances in the theory of dominant lethality are reviewed and models are presented for radioinduced dominant lethality in the wasp Habrobracon and the fly Drosophila. Applications of chemical sterilants for insect control are discussed briefly. It is postulated that a chemical sterilant may be found for field use that will have no debilitating effects on vertebrates. (C.H.)

43226 (ORNL-P-394) CONCERNING THE CAPACITY OF LYMPHOCYTES TO GIVE RISE TO ERYTHROPOIESIS. Joan Wright Goodman (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 17p. (CONF-717-1)

From CNRS Meeting on Graft of Allogenic Hematopoietic Cells, Paris, Sept. 1964.

The heavily irradiated mouse has provided an excellent medium for the study of differentiation and proliferation of transplanted hemopoietic cells. In this apparently ideal environment, not only transplanted bone marrow, but hemopoietic stem cells found among peripheral blood leukocytes and peritoneal fluid cells are stimulated to differentiate into all mature formed elements normally found in blood and lymphatic tissues. Recent data on lymphocyte transformation, as well as attempts to correlate marrow lymphocyte numbers with hematopoietic potential, have stimulated interest in the small lymphocyte as a pluripotential stem cell. Heavily irradiated mice were transfused with large numbers of lymph-node lymphocytes, and histological and ^{59}Fe-uptake data were collected during the second week after transplantation to determine the capacity of lymphocytes to support red cell formation. Good regeneration of lymphatic tissues, including many plasma cells and germinal centers, was seen in lymphocyte-transfused mice but not in radiation controls. Marrow, spleen red pulp, and thymus were depleted of cells in both experimental and control groups. Only an occasional mouse from these experiments showed small areas of erythropoiesis or moderate thymus regeneration. ^{59}Fe-uptake data from lymphocyte-treated mice substantiated the histological finding that lymphocytes have no significant capacity to give rise to erythropoiesis. (auth)

43227 (ORNL-P-419) CYTOGENETIC EFFECTS OF RADIATION IN MAN. Michael A. Bender (Oak Ridge National Lab., Tenn.). Aug. 31, 1964. Contract W-7405-eng-26. 3p. (CONF-733-1)

From 8th International Congress of Internal Medicine, Buenos Aires, Nov. 1964.

Results are reviewed from studies of the effects of radiation on the chromosomes of human somatic cells. It is pointed out that such studies provide direct evidence on which to base estimates of human radiosensitivity and provide a basis for the use of chromosomal aberrations as a biological dosimeter in cases of human exposure. Cell systems used for such studies include tissue cultures of various organs, such as skin or kidney, bone marrow cells, and peripheral leukocytes studied in their first post-radiation division. Bone marrow and leukocytes are suitable for *in vivo* analysis of aberrations induced by irradiations. Analyses of chromosome aberrations in 3 individuals exposed in 3 nuclear criticality accidents and one individual exposed in a γ radiation accident gave good agreement with parallel *in vitro* blood exposures. The coefficients of human chromosome aberration induction observed were 1×10^{-3} deletions per cell per rad and 0.5×10^{-3} rings and dicentrics per cell per rad^2 for x and γ radiation. Those for fission spectrum neutrons were 4.5×10^{-3} deletions per cell per rad and 5.5×10^{-3} rings and dicentrices per cell per rad. Long-term studies of these and other cases were used to determine the time-course of aberration loss, and established that some aberrations persist for at least twenty years. The presence of such chromosomal aberrations does not generally lead to any clinical manifestations. (C.H.)

43228 (ORNL-P-449) MECHANISMS OF DOSE-RATE EFFECTS: INSIGHTS OBTAINED FROM INTENSITY AND FRACTIONATION STUDIES ON CHROMOSOME ABERRATION INDUCTION. Sheldon Wolff (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 26p. (CONF-732-2)

From Conference on the Mechanisms of the Dose Rate Effect at the Genetic and Cellular Level, Oiso, Japan, Nov. 1964.

Results are reviewed from a number of studies on the effects of radiation dose intensity and dose fractionation on the induction of chromosome aberrations. Evidence is presented that indicates that intracellular repair of one-hit genetic lesions can occur. It is pointed out that two-hit intergenic mutations have been shown to undergo resti-

tutional repair. Fractionated dose techniques have been used to separate effects on repair from breakage, and by inhibition of various metabolic processes between two doses of radiation, some insight has been gained into chemical processes involved in repair. (C.H.)

43229 (ORNL-P-472) RELATION OF THE STUDIES ON MUTAGENESIS IN PARAMECIUM TO THE DOSE RATE PROBLEM. R. F. Kimball (Oak Ridge National Lab., Tenn.). [1964]. Contract [W-7405-eng-26]. 17p. (CONF-732-1)

From Conference on the Mechanisms of the Dose Rate Effect at the Genetic and Cellular Level, Oiso, Japan, Nov. 1964.

Mutation studies with Paramecium aurelia demonstrated that most, if not all, mutations arise from initially reparable premutational damage. This generalization seems to hold for such diverse mutagens as x rays, alpha particles, ultraviolet light, and alkylating agents. These studies also demonstrate that large variations in the yield of one-hit mutations occur during the cell cycle. Despite these two features, there is little if any dose rate and dose fractionation effect with x-ray induced, one-hit mutations. The reason for this seems to be that mutagenic doses of x rays have almost no effect on the cell cycle and no effect on preautogamous survival of this organism. Thus the effects of radiation on repair mechanisms, on the cell cycle, and on cell survival, which have been used to account for dose rate and dose fractionation effects in other organisms, are missing in Paramecium. Mutagenic doses of ultraviolet light do affect the cell cycle in Paramecium, and, in keeping with expectation, fractionation of the ultraviolet dose has clear effects on mutation yield. (auth)

43230 (ORNL-TM-924) THE ORNL SPACE BIOLOGY PROGRAM ANNUAL REPORT PERIOD ENDING, JUNE 30, 1964. G. E. Stapleton (Oak Ridge National Lab., Tenn.). Contract W-7405-eng-26. 52p.

Work is described that was performed to July 1, 1964, in the ORNL Space Biology Program through an interagency agreement with the U. S. Atomic Energy Commission and the National Aeronautics and Space Administration. The Program is arbitrarily divided into ground-based experiments, the Basic Supporting Program, and the in-flight experiments and preparatory testing, the Biosatellite Program. This subdivision is more apparent than real, since the Basic Program supplies base-line data of importance for the Biosatellite and other in-flight experiments. The time table or schedule determined that the Basic Program would precede to a great extent the Biosatellite Program, the latter being on strict schedule determined by NASA. As of July 1964, the Basic Program has proceeded to the investigation of the relative biological effectiveness (RBE) of protons of energies ranging from 22 to 750 Mev compared with 250 kvp x rays. The biological materials that can be made into very thin samples have been subjected to heavy ions as well as protons. Plans for a systematic assessment of long-term effects induced by protons in mice are now complete. Three groups in the Biology Division will participate in two in-flight experiments on Biosatellite A and Gemini III. The former is a radiation-source-bearing satellite scheduled for late 1965, and the latter is a manned space flight scheduled for late 1964 carrying a self-contained source-bearing package. Progress in preparatory experiments is discussed briefly. (auth)

43231 (TID-21203) IMMUNE RESPONSES BY DOMESTIC RUMINANTS TO IRRADIATED GASTROINTESTINAL NEMATODES. Termination Report. Stuart E. Knapp (Oregon State Univ., Corvallis). Sept. 1964. Contract AT(45-1)-13-76. 51p.

Progress is reported in studies on the immunogenic properties of ruminant nematode larvae attenuated with ionizing radiation. Topics discussed include the radiation dose necessary to inhibit reproduction by the parasites and still permit a pathogenic effect in the host similar to that produced by nonirradiated nematodes, the number of irradiated larvae required to provoke an immune response in the host, the stage in the parasite's life cycle when irradiation is most effective, and the level of protection provided by the immune response of the host to irradiated larvae. Data are presented from studies of Ostertogia circumcincta, a parasite that stimulates an active tissue reaction of the host's gastric mucosa, Haemonchus contortus, and Trichostrongylus colubriformis in sheep. Procedures are described for raising helminth-free lambs, the establishment of pure cultures of nematodes in donor lambs, and the γ irradiation of helminth larvae. Results are reported from studies on the development of irradiated and normal nematode larvae in lambs, measurements of the effectiveness of irradiated-nematode vaccine in lambs, and measurements of the immune response of lambs to a larvae vaccine. (C.H.)

43232 (TID-21204) FINAL REPORT [ON RADIOBIOLOGY]. A. L. Soderwall (Oregon. Univ., Eugene). Sept. 16, 1964. Contract AT(45-1)-1378. 16p.

Results are summarized from studies on the effects of exposure of female hamsters to low doses of whole-body x radiation on reproductive function. Emphasis was placed on the simulation of aging in irradiated animals. Changes in reproductive function similar to those observed histologically in much older animals were observed in irradiated females killed at 14 mo. of age. Data are included from studies on radiation effects on the blood picture, intestinal tract, eyes, life span, and hair pigmentation, and the effects of vitamin E on reproductive function in irradiated and aging female hamsters. (C.H.)

43233 (UR-649) IRREPARABLE INJURY FROM PROMPT RADIATION DOSES AS MEASURED BY PROTRACTED DOSES IN MICE. Henry A. Blair (Rochester, N. Y. Univ. Atomic Energy Project). Aug. 7, 1964. Contract W-7401-eng-49. 24p.

The experiments on mice of several authors are examined in which evenly divided or protracted exposures until actual death to ionization radiation at least 50 R per day are used as a measure of the long persisting effect (irreparable injury) from a prior prompt dose, or a series of such doses. Because the total dose of the protracted test exposure is reduced in proportion to the prior test exposure it is concluded that the irreparable injury from either exposure is proportional to dose. However, the data, as measured, give a value of about 2.6 for the ratio of irreparable injuries of prior to test dose. Because this ratio is probably actual unity the difference is attributed to the experimental method of continuing the test exposure to actual death instead of stopping earlier in anticipation of 30 day death. (auth)

43234 ULTRASTRUCTURAL AND BIOCHEMICAL CHANGES IN MUSCLE CELLS AFTER X-IRRADIATION. A. Portela, J. C. Pérez, P. Stewart, María Luchelli, E. Strajman, and Marion Hiñes (Universidad, Buenos Aires and Emory Univ., Atlanta). Acta Physiol. Latinoam., 14: 86-8(1964).

Evidence that 100,000 R doses of x rays produce altera-

tions in ultrastructure of frog muscle cells is presented. Several hours after irradiation, damaged areas with a progressive disorganization of membrane structure in mitochondria and sarcotubular system are observed. Appreciable changes in the myofibrils appear only much later after irradiation (24 to 45 hr). A correlation has been attempted between these ultrastructural changes and previous biochemical findings. (auth)

43235 THOROTRAST GRANULOMAS. William J. Barry and C. Jules Rominger (Misericordia Hospital, Philadelphia). Am. J. Roentgenol., Radium Therapy Nucl. Med., 92: 584-90(Sept. 1964).

Thorotrast was implicated in over 60 cases of neoplasms. Relatively few reports of granulomas occurring at the site of injection were reported. Two cases added to this number are reported. (auth)

43236 THE EFFECT OF X-RAYS ON THE PROTEIN SYNTHESIS IN VITRO. A. Wacker and P. Chandra (Universität, Frankfurt am Main). Angew. Chem. Intern. Ed. Engl., 3: 636-7(Sept. 1964).

The effects of x radiation on the synthesis of polyphenylalanine and polylysine in vitro were studied. The incorporation of phenylalanine falls off in dependence on the radiation dose, 50% inhibition being obtained with about 45 kR. On the other hand, the synthesis of polylysine is inhibited by only slightly over 30% by a dose of even 160 kR. (P.C.H.)

43237 THOROTRAST-INDUCED CARCINOMA OF THE LIVER. A CASE REPORT INCLUDING RESULTS OF WHOLE-BODY COUNTING. D. A. Person, T. Sargent, and E. Isaac (Santa Clara County Hospital, San Jose, Calif.). Arch. Surg., 88: 503-10(1964).

A case is reported of thorium dioxide induced bile duct carcinoma. Whole-body counter data, including identification and quantitation of radioactivity, were obtained. The value of such data as an aid in determining therapy is discussed. Surgical excision of localized deposits of thorium is recommended. (Excerpta Med., Sect. XVIII, 1: (Sept. 1964))

43238 DOES RADIATION IMPERIL ASTRONAUTS? Jerzy Pomaski. Astronautyka, No. 2, 18-19(1964).

A general discussion is given on the nature and biological effects of ionizing cosmic radiation. The major part of such radiation is constituted by corpuscular rays, chiefly protons. Other particles are heavier nuclides such as the nuclei of carbon, nitrogen, oxygen, iron, and other elements. Protons are also present in the radiation belts surrounding the earth; calculations show that of the total number of protons in the inner radiation belt, 2×10^4 particles/cm^2/sec have energies in excess of 40 Mev. During solar flares, this number may increase, and the energy of individual particles may exceed 1000 Mev. Values of the relative biological effectiveness as determined by Soviet and American authors for various biological tissues and various types of radiation are tabulated. Cosmic radiation causes disturbances in physiological processes. Such effects are divided into somatic and genetic effects. Particularly sensitive are gametes, skin, the lens of the eye, bone marrow, spleen, lymph nodes, and intestinal epithelium. Sensitivity to radiation depends on the maturity of the cells. All the doses of radiation are cumulative because of irreversible changes in the cells. The maximum permissible dose of radiation set in the USSR is 30 Rads, and 100 Rads is the value set in the USA. At the present time, the preventive use of drugs to counteract the effects of radiation is the most effective means of protecting astronauts. Antiradiation drugs have been given to Soviet astronauts. (OTS)

43239 THE LIPOPROTEINS OF HEPATIC CELL HYALOPLASM IN ACUTE RADIATION SICKNESS. V. D. Blokhina and E. M. Belyaeva. Biochemistry (USSR) (English Transl.), 28: 217-20(Mar.-Apr. 1963). Translated from Biokhimiya, 28: 272-6(Mar.-Apr. 1963).

During the fractionation of the hepatic cell hyaloplasm of rabbits by a method similar to that of Cohn six fractions were isolated, three of them (sediments 1 and 2 and supernatant liquid 6) appearing as lipoproteins. In sediment 1, corresponding to the α-lipoproteins of blood serum, there was a high content of firmly bound lipids and an extremely low amount of loosely bound lipids. In the supernatant liquid 6, similar to the β-lipoproteins of blood serum, this difference is less pronounced. In its lipid composition sediment 2 approaches cytoplasmatic microstructures. In acute radiation sickness the content of fatty acids in sediments 1 and 2 increases within 2 and 6 h after irradiation. Apart from this, the amount of loosely bound lipids increases in sediment 2. These changes precede the appearance of lipemia. (auth)

43240 EFFECTS OF X-RAYS ON RNA AND RNA METABOLISM IN HeLa CELLS. E. V. Boudnitskaya, M. Brunfaut, and M. Errera (Université Libre, Brussels). Biochim. Biophys. Acta, 80: 567-73(Apr. 27, 1964).

The effect of x rays on RNA and RNA metabolism was studied in HeLa cells in culture. When prelabelled cells were irradiated, RNA was radiosensitive when it had just been formed. The nucleolar RNA seemed sensitive than that of the rest of the nucleus. When irradiated cells were incubated in ^{3}H-cytidine, the uptake of the label in RNA was considerably more depressed for short incubation times, indicating that the damage to the mechanism of RNA synthesis can be repaired. When prelabelled cells were irradiated and then transferred to a non-radioactive medium, the transfer of label from nuclear to cytoplasmic RNA was also inhibited. (auth)

43241 THE RESISTANCE OF MICROCOCCUS RADIODURANS TO ULTRAVIOLET RADIATION. I. ULTRAVIOLET-INDUCED LESIONS IN THE CELL'S DNA. Jane K. Setlow and D. E. Duggan (Oak Ridge National Lab., Tenn.). Biochim. Biophys. Acta, 87: 664-8(Aug. 12, 1964).

Micrococcus radiodurans seems to have a very efficient DNA repair mechanism. The organism is very resistant to ultraviolet radiation, although the DNA is not exceptionally resistant to ultraviolet damage, as indicated by thymine dimerization. (auth)

43242 THE DISTRIBUTION OF CATHEPSINS B AND C IN RAT TISSUES. J. M. W. Bouma and M. Gruber (Rijksuniversiteit, Groningen, Netherlands). Biochim. Biophys. Acta, 89: 545-7(Sept. 18, 1964).

Data are presented on the activities of cathepsin B, C, and D, acid phosphatase, and β-glucuronidase in rat tissues. Relatively low values of all enzymes were found in blood, heart, testis, brain, and skeletal muscle. Other organs like liver and kidneys showed quite different values for the different enzymes. High activities of all enzymes were found in spleen. The enzyme activities in rat spleen was determined before and 24 hr after whole-body exposure to 500 R x radiation. No significant differences in enzyme activities were found between irradiated and non-irradiated halves of excised spleen. The specific activities of cathepsins B and C and of acid phosphatase in spleen increased after irradiation of rats. The specific activity of cathepsin

D decreased. It is postulated that if all these enzymes are located exclusively in lysosomes, different tissues must contain lysosomes with widely different enzyme content. (C.H.)

43243 A NOTE ON ACID PHOSPHATASE RELEASE FROM SPLEEN, LIVER AND THYMUS OF RATS. Y. E. Rahman (Argonne National Lab., Ill.). Biochim. Biophys. Acta, 90: 440-2(Aug. 19, 1964).

The existence of lysosomes, a special group of subcellular particles which are found in many different animal cells and which play an important role in intracellular catabolic processes, is discussed. The functions of these lysosomes are far from clear. Factors governing the release of lysosomal enzymes were studied in rat liver, spleen, and thymus. Preliminary results showed that whole-body x irradiation or thyrotropic hormone (in vivo) can equally stimulate a more rapid release of acid phosphatase from liver homogenate incubated at pH 5.2 and 37° or 25°. The spleen from rats injected with thyrotropic hormone showed about 20% loss of total acid phosphatase activity after incubation at pH 5.2 and 37° for 3 hr. No loss of activity was found either with spleen acid phosphatase from control rats, or with the liver enzyme with or without thyrotropic hormone injection. After x irradiation, no change of spleen acid phosphatase release (as compared with the non-irradiated controls) was found after 3 hr incubation at pH 5.2 and 37° or 25°. Extensive loss of liver and spleen acid phosphatase activities was found after incubation at pH 4.2 and pH 8.0. It is postulated that the functional mechanism as well as the enzymatic binding of lysosomes from various tissues may be very different from each other, and that these differences are certainly of a complex nature. (C.H.)

43244 STUDIES ON THE EFFECTS OF IRRADIATION OF CELLULAR PARTICULATES. IV. THE TIME SEQUENCE OF PHOSPHORYLATION CHANGES IN VIVO. Henry T. Yost, Jr., Robert M. Glickman, and Laurence H. Beck (Amherst Coll., Mass.). Biol. Bull., 127: 173-85 (Aug. 1964).

White male rats of the Sprague-Dawley and Wistar strains were exposed to 800 R total-body and partial-body γ radiation. Estimates of the damage to the oxidative phosphorylation mechanism of spleen, liver and testis of the Sprague-Dawley rats and of the spleen of Wistar rats were made. Similarly, changes in the histology of the spleen follicles were followed, as well as alterations in the circulating lymphocyte population. In general, there seems to be no indication of an initial resistance to radiation; however, there are obvious differences in the recovery rate between the strains and between the total-body and partial-body irradiated animals. Changes in oxidative phosphorylation closely parallel the histological changes and thus can be used as a rapid technique for accessing indirect damage. The data suggest that radiation resistance is more a matter of recovery rate than of initial resistance. (auth)

43245 EVIDENCE FOR CARBONYL COMPOUND IN MEATS IRRADIATED WITH GAMMA RAYS. Jean Moore and Luciene Richou (Service Veterinaire du Departement de la Seine, Paris). Bull. Acad. Vet. France, 36: 349-59 (Oct. 1963). (In French)

The detection and quantitative determination of the aldehydes produced in meats irradiated with gamma rays were studied. The aldehydes extracted from the substrate by trichloracetic acid were colorimetrically determined with 2-thiobarbituric acid or 3-methyl-2-benzo-thiasolone hydrazone (MBTH). The presence of aldehydes was investigated in beef, veal, mutton, horse meat, and pork. The experimental conditions and the chemical procedures are given. The use of MBTH was preferable because the reaction was specific and easy to initiate without recourse to heat that could modify the aldehydes. (J.S.R.)

43246 RADIATION ENTEROPATHY OF THE SMALL BOWEL. Irving B. Rosen and Bernard J. Shapiro. Can. Med. Assoc. J., 91: 681-8(Sept. 26, 1964).

The features of radiation injury of the small bowel are reviewed to focus attention on this uncommon but persistent problem which usually arises in women undergoing treatment for gynecological malignancy and which may be confused with recurrence of the malignant growth. Intestinal perforation, bleeding, obstruction and fistulas have all been observed in patients with radiation enteropathy. Three cases in which these complications occurred are reported. Early excisional surgery is considered to be the preferred treatment, although conservative surgical procedures have been used for patients who are very ill or for those with diffuse bowel changes. Medical measures alone have not been successful, but have been utilized in preoperative preparation. (auth)

43247 THE EFFECT OF RADIATION ON THE ION METABOLISM IN THE SALIVARY GLANDS OF RATS. J. Ondráčková, M. Rakovič, and V. Gregora (Charles Univ., Prague). Casopis Lekaru Ceskych, 103: 295-8(1964).

In rats irradiated with a dose of 1,000 R of x radiation there appeared, 72 and 96 hr after radiation, an increased elimination in the saliva of previously applied radioactive sodium, and, 6, 24, and 48 hr after radiation, a similar increased elimination of radioactive rubidium. The parotid glands of an irradiated rat accumulated potassium, contrary to the majority of other organs in which, after radiation, potassium and rubidium concentrations normally fall or remain constant. (Excerpta Med., Sect. XXIII, 1: (Sept. 1964))

43248 ACCELERATION OF HEALING OF SKIN LESIONS BY THE FACTORS OF RADIORESTORATION. J. Loiseleur, L. Catinot, and A. de Vomecourt (Institut Pasteur, Paris). Compt. Rend. Soc. Biol., 158: 443-7 (1964). (In French)

The restoration factors which appear either after two radiolesions or after two scarifications were compared in order to determine which lesions are most effective for the formation of restoration factors. The efficiency of radiovaccination was confirmed by studies on rats receiving total doses of 2000, 3000, or 4000 R x radiation either in single doses or in two equal doses. The fractionated irradiation was less harmful than the single dose. The time interval separating the doses was an important factor. The effect of the serum of the radiovaccinated animals on the scarring of a lesion was tested, and it was shown to accelerate the scarification of any type of open wound. (J.S.R.)

43249 CONTRIBUTION TO THE STUDY OF RADIOSENSITIVITY OF CERTAIN SAHARAN ARTHROPODS. STUDY OF THE NUCLEIC ACID CONTENT OF THEIR SOFT PARTS. REPORT OF A POSSIBLE INCREASED RADIORESISTANCE. M. Bonifay, P. Niaussat, and R. Bourcart. Compt. Rend. Soc. Biol., 158: 486-90(1964). (In French)

The total content of ribonucleic and desoxyribonucleic acids was studied before and after irradiation by colorimetric methods in several adult Saharan arthropods whose

radioresistance was high. One of the results observed seemed to be an important decrease of the DNA after strong γ irradiation. There appeared to be a relation between the radiosensitivity of a species and the mean DNA content in its tissues. The lower the DNA content, the greater appeared the resistance of the organism to radiations. A possible correlation was suggested in species that have a marked evolutive inertia, such as the scorpion. (tr-auth)

43250 RADIATION SENSITIVITY OF THE MOUSE OVARY: FERTILITY AND OOCYTE SURVIVAL. Hannah Peters and Emilia Levy (Finsen Lab., Copenhagen). Fertility Sterility, 15: 407-18(July-Aug. 1964).

The radiation sensitivity of the mouse ovary was evaluated by testing the reproductive performance of animals irradiated with a single dose of radiation early in life. The sensitivity varies markedly between birth and maturity: It rapidly increases during the first three weeks of life, after which a progressive decrease is noted as the age of maturity is approached. A correlation exists between the survival of oocytes at the time the animal becomes mature and its subsequent reproductive performance. The number of offspring an animal produces has no relation to the total number of oocytes still present at the age of maturity. However, a clear correlation can be made between the number of growing and large oocytes surviving at the age the animal begins reproductive life and the number of young it subsequently produces. (auth)

43251 ANALYSIS OF CHROMOSOME 4 IN DROSOPHILA MELANOGASTER. I. SPONTANEOUS AND X-RAY-INDUCED LETHALS. B. Hochman, H. Gloor, and M. M. Green (Univ. of Tennessee, Knoxville; Rijksuniversiteit, Leiden; and Univ. of California, Davis). Genetica, 35: 109-26(1964).

An analysis of 17 spontaneous and 37 x-ray-induced lethal mutations on the fourth chromosome of Drosophila melanogaster has revealed a minimum of 22 loci on this microchromosome capable of mutating to lethality. A few of these loci had been identified earlier by their visible alleles, but 16 are new discoveries. Seven of the 22 lethal loci are situated within that proximal section of the right arm of chromosome 4 delimited by the Minute-4 deficiency. Genetic tests indicate that two translocations and five deletions are included among the lethals of x-ray origin. No chromosomal aberrations were found among the spontaneous mutants. Allelism was encountered both within and between lethals from the two groups. Three independent estimates of the total number of lethal loci to be expected on this small autosome are presented. These appraisals are based on: the size of the Minute-4 deficiency; the number of bands in salivary chromosome 4; and the frequency of recurrence among the lethals. Considering the uncertainties inherent in each determination, the three estimates show remarkably good agreement. (auth)

43252 UV-INDUCED MITOTIC RECOMBINATION IN THE $paba_1$ REGION OF ASPERGILLUS NIDULANS. G. J. O. Jansen (Rijksuniversiteit, Utrecht). Genetica, 35: 127-31 (1964).

UV irradiation of diploid conidia of Aspergillus nidulans induces mitotic recombination within the $paba_1$ region. The frequency of this uv-induced intragenic recombination is enhanced if a short period of incubation in a non-selective medium precedes plating of irradiated conidia in a selective medium. (auth)

43253 MEIOTIC X-Y EXCHANGE AND NONDISJUNCTION INDUCED BY IRRADIATION IN THE DROSOPHILA MALE. S. Zimmering and C. K. Wu (Brown Univ., Providence). Genetics, 50: 633-8(Oct. 1964).

Drosophila melanogaster males of the composition yv/y^+Y were x rayed as prepupae and mated upon eclosion to yv; bw females. The phenotypically vermilion female offspring which were nonyellow were tested further using a genetic scheme which permitted an unequivocal distinction between those that arose following X-Y nondisjunction and those that arose following $X\text{-}Y^s$ exchange. The results from these tests demonstrated that $X\text{-}Y^s$ exchanges are recovered appreciably more frequently than X-Y nondisjunctionals with ratios as high as 6–7 : 1, and disclosed a class of exceptional females interpretable as having arisen from the recovery of Y-autosome translocations induced in primary spermatocytes. Applying a correction for the occurrence of these translocations not tested in previous prepupal experiments involving the B^sYy^+ the ratios of induced $X\text{-}Y^s$ exchanges to nondisjunction nonetheless turn out to be as high as those found in the present experiment. It seems likely that the explanation for the sharp disagreement between these results and those reported by Sävhagen (1961) is related to the difference in the genetic test used to distinguish between these two kinds of females, with only the present test being critical. (auth)

43254 A LOCUS FOR RADIATION SENSITIVITY IN ESCHERICHIA COLI B_{s-2}. Joseph Greenberg (Palo Alto Medical Research Foundation, Calif.). Genetics, 50: 639-48(Oct. 1964).

Radiation resistant Escherichia coli K-12 donors were crossed with the radiation hypersensitive mutant of strain B, B_{s-2}. Relative to radiation resistance three types of recombinants were observed: Those as hypersensitive as B_{s-2} (UV^s), those as sensitive as B (UV^{r+}) and those as resistant as the K-12 donor ($UV^{r\,2+}$). These phenotypes resulted from the interaction of two genes concerned with radiation resistance. One of the genes, UV_2^r, was closely linked to lac; the other, UV_s^r, was closely linked to mal, probably mal_5. Recombinants which received from the donor only UV_3^r were phenotypically like strain B; those which received both UV_2^r and UV_3^r were phenotypically like K-12; those which received neither or only UV_2^r were like strain B_{s-2}. (auth)

43255 INTERCHROMOSOMAL EFFECTS ON SOMATIC RECOMBINATION IN DROSOPHILA MELANOGASTER. Amiram Ronen (Hebrew Univ., Jerusalem). Genetics, 50: 649-58(Oct. 1964).

Somatic crossing over was studied in y/sn females. The frequency of single and twin spots per fly was higher in the presence of the autosomal inversions Curly and Dichaete, than in a control group where the autosomes were structurally and genetically homozygous. The spot-frequency was even higher in females which had been irradiated as third-instar larvae with 1170 R of x rays. The data indicate that both spontaneous and induced recombination are restricted to the proximal part of the chromosome. In the irradiated group, there were fewer induced spots in the inversion-carrying females than in the normal ones. It is suggested that centric pairing in the X chromosome, and therefore its chance to undergo induced somatic recombination, are impaired in the presence of the autosomal inversions. (auth)

43256 STUDIES IN ULTRAVIOLET MUTAGENESIS IN DROSOPHILA INVOLVING TREATMENT OF INSEMINATED FEMALES. Luolin S. Browning and Edgar Altenburg (Univ. of St. Thomas, Houston, Tex.). Genetics, 50: 695-9(Oct. 1964).

In order to circumvent the problem posed by the low penetrating power of ultraviolet light (uv), a new technique has been devised for the induction of mutations by uv in Drosophila. This consists in getting females immediately after mating, everting their vaginas by pressure applied to the abdomen, and then exposing the vaginas to uv. Sperm were treated by the above technique and the progeny tested by the Basc (Muller-5) technique for recessive sex-linked lethals, both whole-body and fractional. Among 711 F_1 females there were 18 whole-body lethals, or 2.5 percent; among 142 of these F_1 females tested for gonadal mosaicism there was only one undoubted mosaic, or 0.7 percent. The ratio of whole-body lethals to fractionals (recovered as gonadal mosaics) is then 2.5:0.7, making the fractionals 22 percent of the total lethals recovered. Among the lethals induced in Drosophila by treatment of adult males with quinacrine mustard, the percent of fractionals is well above that here recorded for uv, and if virtually all uv-induced mutations were fractionals, the percent (recovered as gonadal mosaics) would expectedly be at least as high as that reported for quinacrine mustard. (auth)

43257 CAPILLARY CIRCULATION IN CONTRAST TO HYALURONIDASE ACTIVITY (PERMEABILITY FACTOR) AND SERUM PROTEIN FRACTIONS IN CHRONIC RADIATION SICKNESS. N. I. Gorbarenko and V. A. Bragina. Gigiena Truda i Prof. Zabolevaniya, 7: No. 10, 34-8(Oct. 1963). (In Russian)

Results of the examination of 231 persons exposed to x or gamma radiation are presented. Following a thorough clinical examination, a study was made of peripheral circulation, the permeability of the vessels, blood serum protein fractions and hyaluronidase. In accordance with the degree of the clinical syndrome, the subjects were divided into four groups: persons with radiation contact; persons with initial reactions to chronic radiation exposure; persons with first-degree chronic radiation sickness; and persons with residual manifestations of chronic radiation sickness. It was found that disorders of the capillary circulation, capillary permeability and albumin recession go hand-in-hand with a distinctness of the clinical picture. In persons with residual manifestations, persistent changes in peripheral circulation and capillary permeability were also observed, whereas in persons with initial reactions there was usually increased hyaluronidase activity. (Occupational Safety Health Abstr., 2: No. 8, 1964)

43258 THE ESTIMATION OF THE OVARIAN ENDOCRINE ACTIVITY AFTER RADIOTHERAPY (RADIUM). Ginekol. Polska, 35: 73-9(1964).

Cytological smears in 16 cases were performed in women aged from 36 to 51 yr, where radium was administered because of uterine bleedings and symptoms of ovary dysfunction when no other clinical symptoms were detectable. The endocrine function of the ovary ceased in the 4th week after the beginning of radium therapy, and remained so for a period of 44 to 48 weeks. After this period the renewal of oestrogen secretion was noted. The renewal of the ovarian function was also seen in the cytological smear patterns. Collaterally with the examination of the cytological smears, endometrial biopsies were performed. Radium therapy in cases of persistent uterine bleedings was found to give good results. The bleeding ceased after a short period of time and recurrence of suffering was rare. The persistence of uterine bleeding in the course of radium administration may be a symptom of coexistence of hormonally active ovarian tumors. (Excerpta Med., Sect. XXIII, 1: (Sept. 1964))

43259 DOSE RATE EFFECT ON SURVIVAL OF MICE DURING CONTINUOUS (23-24 hr/day) GAMMA RAY EXPOSURES. J. F. Spalding, T. T. Trujillo, and Paul McWilliams (Los Alamos Scientific Lab., N. Mex.). Health Phys., 10: 709-13(Oct. 1964). (LADC-6161)

Mice were exposed continuously (23 to 24 hr/day) to γ rays at 10 dose rates (0.5 to 24.0 rad/hr) for the duration of life. Life span declined with increasing dose rate. The critical dose rate at which effects changed rapidly from chronic to acute was approximately 3 rad/hr. Dose rate effect (reduced life span) seems to have a similar function whether the total daily dose was delivered in acute fractions or continuously. (auth)

43260 CALCULATION OF RADIATION DOSE FROM PROTONS TO 400 Mev. J. E. Turner, C. D. Zerby, R. L. Woodyard, H. A. Wright, W. E. Kinney, W. S. Snyder, and J. Neufeld (Oak Ridge National Lab., Tenn.). Health Phys., 10: 783-308(Nov. 1964).

The Monte Carlo technique was used to obtain estimates of dose and dose equivalent in a homogeneous tissue slab irradiated by a broad beam of normally incident monoenergetic protons and also for an isotropic flux of protons incident on a homogeneous parallelepiped of tissue. Incident proton energies as high as 400 Mev are considered. The dose is essentially uniform above 200 Mev, where average primary proton ranges become large compared with the mean track lengths of primary protons in the target. At all proton energies the ratio of rem and rad doses is generally about 1.4 if rem dose estimates are based on values of RBE in current use for long-term occupational exposure to ionizing radiation. The contributions to dose from various ranges of LET values which arise in the calculations are presented and discussed. The nuclear interactions considered are cascade and evaporation phenomena. The effect of the presence of pions is assumed to be negligible at incident proton energies not exceeding 400 Mev. An analysis of nuclear interactions is made from the standpoint of dose assessment. From the results of the detailed Monte Carlo calculations a simplified model is derived which permits a rapid and accurate estimation of proton dose. A method of handling RBE in a flexible manner is given also. (auth)

43261 SOME ASPECTS OF THE RADIOSENSITIVITY OF HEPATIC TISSUES. Michele Laddaga (Universita, Pisa, Italy). J. Belge Radiol., 47: 471-89(1964). (In Italian)

A bibliographic review is made of the available data on the radiosensitivity of hepatic tissues. The cytological modifications observed in at rest and regenerating tissue are summarized. The latency of the lesions observed is considered, and their behavior after repeated regenerative stimulations is discussed. Attempts to modify the damage observed in the hepatic cells are reviewed. (J.S.R.)

43262 DECLINE IN COLONY-FORMING ABILITY OF MARROW CELLS SUBJECTED TO SERIAL TRANSPLANTATION INTO IRRADIATED MICE. L. Siminovitch, J. E. Till, and E. A. McCulloch (Univ. of Toronto and Ontario Cancer Inst., Toronto). J. Cellular Comp. Physiol., 64: 23-31(Aug. 1964).

Experiments were carried out in which cells originally derived from normal adult marrow were compared with their progeny with respect to the property of colony-formation. This was accomplished by measuring the colony-forming ability of the cells at the beginning and the end of each of a series of retransplantations in heavily

irradiated recipient mice. The results of these experiments indicate that, with repeated passage, the capacity for self-renewal of colony-forming cells is reduced, until it eventually reaches an indetectably low level. This decrease in colony-forming activity resulting from repeated transfer of cells to new irradiated hosts is termed decline. The existence of decline shows that new colony-forming cells are not identical to their progenitors since they differ in the capacity for self-renewal. Further, loss of colony-forming ability with repeated passage suggests that the proliferative capacity of normal hemopoietic colony-forming cells, though extensive, is not unlimited. (auth)

43263 MOLECULAR WEIGHT OF HUMAN CHORIONIC GONADOTROPIN AS ESTIMATED BY MEANS OF RADIATION INACTIVATION OF BIOLOGIC ACTIVITY. Martin Nydick, Roger J. Berry, and William D. Odell (National Cancer Inst., Bethesda, Md.). J. Clin. Endocrinol. and Metab., 24: 1049-54(Oct. 1964).

The rate of radiation inactivation of human chorionic gonadotropic hormone and crude kaolin-acetone extracts of pregnancy urine caused by 2.0 Mev electrons was studied. Four bio-assays were used: ovarian hyperemia and uterus weight increase in intact, immature female rats; and prostate and testes weight increments in hypophysectomized male rats. The dose of radiation required to reduce activity to 37% (D_{37}) was obtained by measurement of the slope of a graph of logarithm of percentage activity remaining plotted against radiation dose in rads. From these data estimations of molecular weight were made. The slopes, D_{37}, and molecular weights were similar as measured by the 4 bio-assays for both the partially purified HCG and the pregnancy urine extracts. The average molecular weight was 30,500. Methods of application of radiation inactivation to hormonal materials are presented. The possible significance of these data is discussed. (auth)

43264 ANTIBODY RESPONSE TO THYROID IRRADIATION. P. O'Gorman, J. S. Staffurth, and Maureen R. Ballentyne (Brook General Hospital, Woolwich, Eng. and Lewisham Hospital, London). J. Clin. Endocrinol. and Metab., 24: 1072-5(Oct. 1964).

Serial measurements of thyroid auto-antibody titers by complement fixation and tanned red cell agglutination methods have been made in 30 patients with thyrotoxicosis, before and following treatment with radioactive iodine. A rise in titer by one or both methods was demonstrated in 18 subjects. In 13 it was transient, the maximum response being observed between 4 and 40 weeks, whereas in 5 the rise in titer was delayed and persisted throughout the period of observation. Five subjects developed myxedema; 2 of these had a high initial titer of antithyroglobulin while the other 3 all had a rise in antibody titer after treatment. The findings are discussed, and it is suggested that physical trauma to the thyroid caused by irradiation may lead to the development of an auto-immune process in some patients. (auth)

43265 EFFECTS OF SPACE FLIGHT IN VOSTOK-5 AND VOSTOK-6 ON TRADESCANTIA PALUDOSA MICROSPORES. N. L. Delone, V. F. Bykovskii, V. V. Antipov, G. P. Parfenov, V. G. Vysotskii, and N. A. Rudneva. Kosmich. Issled., 2: 320-9(Mar.-Apr. 1964). (In Russian)

Effects of cosmic flight on Tradescantia paludosa microspores were studied in order to determine effects of weightlessness and cosmic radiation on herediatry structure. The data indicated three types of mutation: chromosomic aberrations, disturbance in mitosis, and stimulation of cell growth. It was postulated that chromosome rearrangements were induced by dynamic factors and the disturbance of mitosis by weightlessness. (tr-auth)

43266 THE FUNCTIONAL STATE OF THE THYROID GLAND FOLLOWING IRRADIATION WITH FAST NEUTRONS. T. P. Sivachenko (Kiev Medical Inst. for Graduate Studies and Inst. of Physiology, Academy of Sciences, Ukrainian SSR). Med. Radiol., 9: No. 8, 28-31(Aug. 1964). (In Russian)

The influence of neutron irradiation on the functional state of the thyroid gland was studied on 114 male rats. The animals were subject to fast-neutron irradiation in a dose of 175, 200, and 300 rad. Thermal neutrons were absorbed by special filters. Investigations of the functional state of the thyroid gland (gas exchange, radioiodine accumulation in the thyroid gland, the content of hormonal radioiodine in the blood serum) were carried out 1 to 10 days and one month after irradiation. The data derived testify to the fact that the thyroid gland is very sensitive to the effect of neutron irradiation. Changes of the functional state depend on the irradiation dose and terms of investigation. Neutron irradiation in a dose of 300 rad after 24 hours causes an inhibition of the functional state of the thyroid gland. Irradiation in a dose of 200 and 175 rad after 24 hours and 10 days increases insignificantly the thyroid functional activity, whereas after one month (a dose of 200 rad) — inhibits the latter slightly. (auth)

43267 PERMEABILITY DISTURBANCES OF SKIN CAPILLARIES IN THE COMBINED EFFECT OF RADIOIODINE AND NOISE. T. Mukhamedov and Sh. I. Zyaeva. Med. Radiol., 9: No. 8, 34-7(Aug. 1964). (In Russian)

Changes in the permeability of skin capillaries occurring in protracted administration of radioiodine are of phase nature; from the 3rd to 4th month of the experiment there was noted a considerable rise and then a gradual decline in the permeability below the initial values. Noise (100 to 105 db) causes a stable rise in the permeability of skin capillaries. A maximal permeability increase (22 to 26% in comparison with the initial values) was observed after a 7 to 8-month-long effect of noise. In combined action of both factors changes in the permeability of skin capillaries are the same as in the effect of radioiodine alone, however they developed earlier and were more pronounced. (auth)

43268 THE ASSESSMENT OF DOSES AND THE POSSIBILITY OF CLINICAL RECOGNITION OF THE DISEASE ASSOCIATED WITH Po^{210} AFFECTION. A. K. Guskova, R. D. Drutman, M. S. Malysheva, and V. A. Soldatova (Inst. of Industrial Sanitation and Occupational Diseases, Academy of Medical Sciences, USSR). Med. Radiol., 9: No. 8, 51-60 (Aug. 1964). (In Russian)

The estimation of tissue doses, the data of 1½- to 2-year clinical observations over four adolescents affected with ^{210}Po in approximate quantities of 10.6 to 0.52 μC are described. In such doses there is no distinct clinical syndrome of radiation sickness, however, upon meticulous investigation the authors revealed some reactions of organs and systems most affected. Some shifts in the liver function, vascular reactions (including transitory changes in the renal plasma circulation and filtration) disclosed a distinct relation between the dose of the isotope and the irradiation values in critical organs. An assessment of the diagnostic difficulties in the detection of affections caused by ^{210}Po in the above dose range is presented and the prog-

nosis and subsequent course in the patients observed are discussed. (auth)

43269 RESEARCH INTO OSSIFICATION. II. INFLUENCE OF RADIATIONS ON THE FIXATION OF Ca^{45} IN THE GROWING BONE. G. S. Marchese, A. Balocco, and S. Baratono (Università, Turin). Minerva Pediat., 16: No. 4, 118-24(1964).

Fixation values of ^{45}Ca administered per os to young rabbits were examined following irradiation under different experimental conditions. In pan-irradiated animals, with only one limb protected, sacrificed 7 days after the last administration of the isotope, a notable increase of calcium fixation was noticed, both in the limb included in the field of the radiations and in the protected one: doses varied from 8 to 320 R, with maximum values for doses of 80 R. By 21 days the values of calcium fixation tended to become equal, with a slight residual prevalence in the animals pan-irradiated with 8 R. Attention is called to the consequences of even minimal doses (8 R) which can be reached in some roentgen-diagnostical examinations carried out on unweaned children. (Excerpta Med., Sect. XXIII, 1: (Sept. 1964))

43270 CONSIDERATIONS ON THE PASSAGE FROM PHYSICAL EFFECT TO BIOLOGICAL EFFECT OF X AND GAMMA RADIATION. Edmondo Balestra (Università, Genoa). Minerva Radiol., Fisioterap. Radiobiol., 9: 39-40(Jan.-Feb. 1964). (In Italian)

The direct and indirect effects of radiation are briefly discussed with respect to the biological action of x and gamma radiation. The principal biochemical effects produced are tabulated. (J.S.R.)

43271 SOCIAL RISK OF GENETIC DAMAGE IN X RAY DIAGNOSIS. E. Benassi, M. Pietrojusti, and A. Torretta (Università, Turin). Minerva Radiol., Fisioterap. Radiobiol., 9: 92-101(Mar. 1964). (In Italian)

The conclusions of the International Committee for Radiologic Protection that the amount of x radiation absorbed by an entire population during x-ray diagnostic procedures is considerably greater than the amount from natural sources are reported. The inevitable increasing risk of genetic damage to an entire population and the need for investigations to establish the magnitude of the dose absorbed by the gonads are considered. The possible injuries caused by irradiation of the gonads during x-ray diagnosis are discussed, and the various methods for evaluating the dose absorbed by the individual and in the entire population are described. Measures which can be adopted to reduce the dose absorbed are proposed. (tr-auth)

43272 TIME OF ACTION OF THE THYMUS. A. Marjorie Cross, J. S. Davies, Barbara Doe, and Elizabeth Leuchars (Royal Cancer Hospital, London). Nature, 203: 1239-41(Sept. 19, 1964).

Experiments are described that gave estimates of the time of function of irradiated thymuses in situ and of unirradiated thymus grafts in irradiated thymectomized animals. Preliminary results suggested that the time course of action of a thymus graft in restoring primary immunological responsiveness to thymectomized irradiated mice was similar to that of the thymus in situ. The pattern of restoration of immunological responsiveness after irradiation appeared to differ depending on whether it was promoted by an irradiated thymus in situ or a thymus graft. The thymus in situ acted slowly for at least ten days post irradiation and then more or less rapidly depending on the sort of immune response potentiated, whereas thymus grafts acted quickly but incompletely within at least five days of their implantation and thereafter showed no further increase in function for about ten days. The hypothesis is advanced that primary immunological responsiveness promoted by a thymus graft accrues in part to cells phylogenetically derived from the graft, rather than from cells that enter the graft from the host animal and afterwards leave it with added immunological potential. The thymus in situ was damaged by irradiation and probably did not have the self-regenerative capacity of the thymus graft, hence it was only able to operate after its repopulation by cells from bone marrow graft, which then become the cells responsible for primary immunological response. (H.M.G.)

43273 RESISTANCE OF FISH EMBRYOS TO CHRONIC IRRADIATION. V. M. Brown and W. L. Templeton (United Kingdom Atomic Energy Authority, Windscale Works, Seascale, Cumb., Eng.). Nature, 203: 1257-9(Sept. 19, 1964).

Eggs of brown trout, Salmo trutta Linn., and plaice, Pleuronectes platessa Linn., were chronically irradiated either by contamination with ^{90}Sr at concentrations between 10^{-7} and 10^{-1} uC/ml water or in uncontaminated water by an external gamma source. Effects of the treatments were assessed in terms of proportions of eggs hatching and of the numbers of abnormal larvae produced. Consideration of all results revealed a variation between similar treatments as great as those arising within, and attributable to, those treatments. Statistically significant reduction in the proportions hatching could not be demonstrated to occur consistently, nor could the degree of reduction be correlated with increasing dose. It is concluded that irradiation of fish eggs by either ^{90}Sr contamination or by an external radiation source at the levels used in the experiments where doses of up to 500 rads were delivered chronically at a rate up to 1R/hr over the development period does not cause significant differences in the proportion hatching or in the number of abnormal larvae produced. (H.M.G.)

43274 RADIATION RESISTANCE AND DEOXYRIBONUCLEIC ACID BASE COMPOSITION OF MICROCOCCUS RADIODURANS. B. E. B. Moseley (Cambridge Univ., Eng.) and Arnold H. Schein. Nature, 203: 1298-9(Sept. 19, 1964).

To verify previous findings that a high guanine cytosine (GC) content was related to radiosensitivity in bacteria, the purine and pyrimidine base ratios were examined in x-irradiated Micrococcus radiodurans. The fact that the highly resistant M. radiodurans had a high GC content contradicted the hypothesis that radioresistance is correlated with a low GC content. A search was also made for odd bases in formic and perchloric acid hydrolysates of the bacterial DNA. None were found. (H.M.G.)

43275 A CASE OF CHRONIC GRANULOCYTIC LEUKEMIA FOUND IN A-BOMB SURVIVORS. Kazuro Ito, Nobuo Tanaka, Nanao Kamada, and Kosuke Okada (Hiroshima Univ.). Proc. Res. Inst. Nucl. Med. Biol. (Japan), No. 5, 108-14(1964). (In Japanese)

A 69-year-old male company employee was exposed to the A-bomb in the basement of a steel-concrete building located at 700 meters from the hypocenter at the age of 52 years in Hiroshima. One month later, he experienced acute radiation symptoms such as bleeding and stomatitis. Since then he felt exhausted after exertion sometimes and at the age of 64 years was hospitalized with chronic gastritis for two months. Moderate anemia (RBC 358 × 10^4, Hb 8.9 g/dl, Ht 32%) and leucocytosis (144,000 per

cmm) were found. The peripheral white differential and bone marrow picture showed a typical picture of CGL. Leucocyte catalase was high and alkaline phosphatase was low. The spleen was palpable one finger breadth below left costal margin and was of moderate consistency. Chromosome counts and karyotype analysis were carried out on the bone marrow cells. The mode of chromosome number was 46 and the Ph chromosome was found in 29% of the encountered mitotic cells. Treatment with Myleran was followed by a good clinical and hematological response. (auth)

43276 EFFECTS OF X-RAYS ON NUCLEIC ACID BIOSYNTHESIS AND ON THE ACTIVITY OF NUCLEASES IN MAMMALIAN CELLS. R. Goutier (Universite, Liege). Progr. Biophys. Biophys. Chem., 11: 53-77(1961).

A survey was made of recent literature on the effects of x radiation on nucleic acid synthesis and nuclease activity in mammalian cells. It is pointed out that extended observations of in vivo effects of x radiation in mammals are hampered by cell death and changes in cell population after irradiation. Relatively high doses of x radiation inhibit DNA synthesis and lower doses delay it. X radiation does not impede the synthesis of nucleotides, which accumulate in many irradiated tissues. The inhibition of DNA synthesis is ascribed to a decrease in phosphorylation of nucleotides leading to nucleotide triphosphates and an inhibition of the specific polymerase. Nuclease activity is almost always increased in tissues and body fluids of irradiated mammals. Reaction mechanisms involved in the activation of DNAases after irradiation are discussed at length. 137 references. (C.H.)

43277 X-RADIATION AND NITROGEN MUSTARD INTERACTION IN MAMMALIAN CELLS GROWN IN VITRO. G. Marin and A. G. Levis (Universitâ, Padua). Radiation Res., 23: 192-202(Oct. 1964).

The interaction of nitrogen mustard (HN2) and x radiation in the induction of lethality in cultured mammalian cells was investigated by testing the effect of HN2 pretreatment on the form of x-ray survival curves, and vice versa. It was found that, whereas the survivors to a single dose of x radiation were sensitized to HN2, no synergistic interaction could be detected when HN2 was used as the sensitizing agent. In addition, a subline with increased chromosome number, shown to be resistant to HN2, did not display cross-resistance to x radiation. The results are interpreted as indicating that the lethal effects of HN2 and x radiation are not entirely due to the same mechanism. (auth)

43278 COMPARATIVE RADIOLABILITY OF AMINO ACIDS OF PROTEINS AND FREE AMINO ACIDS. F. Shimazu and A. L. Tappel (Univ. of California, Davis). Radiation Res., 23: 203-9(Oct. 1964).

Radiation damage to amino acids of ovalbumin and catalase under anaerobic conditions was studied. Paper chromatographic studies of the amino acids of irradiated proteins show that the rank in terms of radiolability of amino acids varied somewhat with proteins. In general, cystine, methionine, phenylalanine, and histidine are the most radiolabile, followed by threonine and tyrosine. A similar trend is also observed in free amino acid systems. The small differences in rank in terms of radiolability of amino acids of different proteins can be ascribed to differences in their amino acid composition and sequence and steric structures in solution. (auth)

43279 EVIDENCE OF A METABOLIC RADIATION DAMAGE WITHOUT DISTURBANCE OF REPRODUCTIVE PHENOMENA IN MICROORGANISMS. G. Giovannozzi-Sermanni and M. Botrè (Universitâ, Rome). Radiation Res., 23: 218-21(Oct. 1964).

A sensitive method is described for detecting metabolic alterations in yeast treated with low doses of β-radiation. The method consists in evaluating the response of cells grown in the presence of the excretion products of irradiated cells of a different strain. (auth)

43280 EFFECT OF IRRADIATION ON THE EXCRETION OF RADIOSODIUM FROM THE GILLS OF GOLDFISH, CARASSIUS AURATUS L. P. N. Srivastava and C. Tachi (National Inst. of Radiological Sciences, Chiba, Japan). Radiation Res., 23: 222-31(Oct. 1964).

The effect of irradiation on sodium excretion was studied in goldfish, Carassius auratus L. Irradiated fish excrete (renal plus gill) much more sodium than the controls. When the fish are injected with radiosodium 1 day after irradiation, the rate of radiosodium excretion through the gills is more than double that of the controls. This rate gradually drops till the fish die. When the head is exposed and the body is shielded against irradiation, the rate of radiosodium excretion is similar to that of the whole-body-irradiated fish; but if the head is shielded and the body is exposed to the irradiation, the fish behave like the controls. It is concluded that the loss of sodium may lead to a significant lowering of osmotic pressure of the body fluids and hence may be one of the major causes of death after irradiation in fish. (auth)

43281 ADRENAL FUNCTION IN THE RHESUS MONKEY AFTER TOTAL-BODY X-IRRADIATION. R. C. Wolf and R. E. Bowman (Univ. of Wisconsin, Madison). Radiation Res., 23: 232-8(Oct. 1964).

The effect of total-body x irradiation on adrenocortical function in the rhesus monkey was studied. Significant elevations in plasma concentrations of 17-hydrocorticosteroids (17-OHCS) were observed 4 hours after an irradiation session and generally again just prior to death. The increased steroid levels could not be attributed to a decrease in cortisol metabolism, since no significant difference in cortisol half-life was observed between irradiated and sham-irradiated monkeys. Adrenocortical capacity, as measured by the increase in 17-OHCS after exogenous ACTH, was elevated after x irradiation. (auth)

43282 ABSCOPAL EFFECTS OF X-IRRADIATION ON MOUSE BONE MARROW. N. B. Kurnick and Naime Nokay (Veterans Administration Hospital, Long Beach, Calif. and Univ. of California, Los Angeles). Radiation Res., 23: 239-48(Oct. 1964).

Direct and abscopal x irradiation effects on bone marrow were investigated at dosages of 400 R, 800 R, 2000 R, and 4000 R in mice. Whereas the combined effect is maximal in reducing the cell number and increasing the average cell DNase activity at 800 R, neither effect alone is produced maximally by doses up to 4000 R. The results suggest a volume-dose function for the abscopal effect, since the effect increases both with increase in dose and with increase in volume irradiated. (auth)

43283 ENHANCEMENT OF THE ANTICONVULSANT ACTION OF ACETAZOLAMIDE AFTER HEAD X-IRRADIATION AND ITS RELATION TO BLOOD BRAIN BARRIER CHANGES. V. Nair, H. Sugano, and L. J. Roth (Univ. of Chicago). Radiation Res., 23: 265-81(Oct. 1964).

The anticonvulsant action of acetazolamide has been found to be enhanced with respect to the potency, time of onset, and duration of action in rats x irradiated to the

head. This effect of acetazolamide was maximal at 48 hours postirradiation. In the irradiated animals stimulation of the sensorimotor cortex elicited only mild seizure discharges, and the evoked discharges were completely suppressed by a dose of acetazolamide which was ineffective in control animals. Penetration of ^{35}S-acetazolamide was found to be increased in four discrete regions of the brain, cerebral cortex, hypothalamus, hippocampus, and cerebellar cortex, at 48 hours postirradiation. Increase in brain drug content was found to be temporally related to the pharmacological effects manifested in the irradiated animal. It was concluded from these studies that x irradiation had induced selective BBB permeability changes, thus permitting an increased selective penetration into the brain of the normally slow-penetrating drug, acetazolamide. (auth)

43284 CHROMOSOME ABERRATIONS IN RADIATION WORKERS. Amos Norman, Motomichi Sasaki, R. E. Ottoman, and R. C. Veomett (Univ. of California, Los Angeles). Radiation Res., 23: 282-9(Oct. 1964).

Chromosome studies were made on a group of thirty-three radiation workers with a lifetime dose in excess of 10 R accumulated at a median dose rate of 1.4 R per year. The frequency of aneuploid cells, quasidiploid cells, dicentrics, and other exchanges is significantly higher in this group than in the population at large. (auth)

43285 LETHAL EFFECTS OF X-IRRADIATION AND INJECTION OF RADIOACTIVE PHOSPHORUS ON RATS IN RELATIONSHIP TO AGE. Melvin R. Sikov and Thomas R. Noonan (Wayne State Univ., Detroit and Univ. of Rochester, N. Y.). Radiation Res., 23: 300-9(Oct. 1964).

Values determined for the $LD_{50(30)}$ of rats exposed to whole-body x irradiation when 21 and 32 days old were, respectively, 360 R and 420 R. Animals exposed when 60 or 100 days old were not found to differ in sensitivity, the $LD_{50(30)}$ being 758 R for both ages combined. The change in sensitivity from weaning to maturity seems to be greater in the rat than in the mouse. Values determined for the $LD_{50(30)}$ of rats injected with ^{32}P at 21, 32, and 100 days of age were essentially the same, ranging from 3.27 to 3.42 mc/kg. Radiation exposures of various tissues of rats injected with 4.5 mc of ^{32}P per kilogram at 21, 32, and 100 days of age have been computed from measurements of concentrations of the isotope experimentally determined at intervals during the first 7 days after injection. Exposure of spleen and other soft tissues was inversely related to age, whereas exposure of bone and bone marrow seemed independent of age. The significance of this has been discussed. Inhibition but not complete suppression of growth occurred in 21- or 32-day-old rats after exposure to x rays or ^{32}P injection. (auth)

43286 ACTIVITY OF PENTOSE CYCLE DEHYDROGENASE SYSTEMS IN LIVER AND IN SPLEEN OF RATS AFTER WHOLE-BODY X-IRRADIATION. Evelyn Kivy-Rosenberg, Joseph Cascarano, and Benjamin W. Zweifach (New York Univ., New York). Radiation Res., 23: 310-18 (Oct. 1964).

The dehydrogenase system activity of homogenates of liver and of spleen was measured microchemically in two components of the pentose cycle-, glucose-6-phosphate-dependent and 6-phosphogluconate-dependent, by the use of a tetra-zolium salt (INT). Assays of liver and of spleen homogenates were done at successive time periods after 625 R WBR of young adult male Charles River rats. The fall in the dehydrogenase system activity for both substrates and both organs was biphasic. The depression in activity was evident immediately after irradiation. The spleen showed a greater effect than did the liver at that time. (auth)

43287 STUDIES ON KOJI FOR SOY SAUCE BREWING. PART 3. ON THE PRODUCIBILITIES OF PROTEASE, AMYLASE AND VITAMINS BY U.V.-INDUCED MUTANTS OF ASPERGILLUS ORYZAE. Ke Ho Lee, Suk Hoon Song, Yun Soo Chung, Chong Hyup Kim, and Kun Hyung Chang. Rept. Army Res. Testing Lab., 2: 26-31(1963). (In Korean)

The enzyme-producing potentials of industrially important strains of Aspergillus sp. were studied. Irradiation of three original isolates of Aspergillus oryzae to ultraviolet rays resulted in the production of mutants which differed from the parent riboflavin and vitamin B_{12} in culture media. Irradiation three strains of Aspergillus oryzae to ultraviolet light produced mutants and two strains of them were selected for soy sauce brewing. The two strains are the physiological mutants of Aspergillus oryzae. Both were found to have superior enzyme activity to their relatives. Aspergillus oryzae uv-induced mutant 172-722 and 569-713 were more powerful than others in the production of riboflavin and vitamin B_{12}. The enzyme activity of these strain were high and decreased only slightly even in 20% solution of NaCl. Aspergillus oryzae uv-induced mutant 172-722 had more powerful protease producibility in wheat bran media than in modified Czapek's solution. On the contrary, Aspergillus oryzae uv-induced mutant 569-713 had more powerful producibility of saccharogenic and dextrinogenic amylase in modified Czapek's solution than in mold bran. Aspergillus oryzae uv-induced mutant 172-722 formed the spore rapidly and Aspergillus oryzae uv-induced mutant 569-713 did ordinarily. It was found from the results that Aspergillus oryzae uv-induced mutant 172-722 is valuable material for the manufacture of soy sauce because of its high protease activity in 20% solution of NaCl. Aspergillus oryzae uv-induced mutant 569-713 is suitable for soy bean mash and for fermented red pepper sauce for its high saccharogenic and dextrinogenic amylase activity in 20% solution of sodium chloride. (auth)

43288 POSTIRRADIATION CHANGES OF RECTAL MUCOSA. II. COMPARISON OF FRAGMENTS OBTAINED WITH AND WITHOUT RECTOSCOPIC GUIDANCE. R. de Dominicis, L. de Felice, and G. Grechi (Università, Florence). Riv. Radiol., 3: 1182-1204(1963).

Results were obtained by the histological and histochemical study of fragments of rectal mucous membrane taken in the course of a rectoscopic examination in patients treated by telecobalt therapy of the pelvis. Results obtained in the present research were compared with those of a previous study, in which the fragments had been taken blindly. From a comparison of the macroscopic and microscopic data a hypothesis is advanced concerning proctitis due to radiation, which characterize the late phase of the postirradiation reaction. (Excerpta Med., Sect. XXIII, 1: (Sept. 1964))

43289 CHANGES OF DEOXYRIBONUCLEASE (DNASE) ACTIVITY BY X-RAY IRRADIATION. K. I. Pravdina. Sb. Robot. Inst. Tsitol., Akad. Nauk SSSR, No. 4, 114-25 (1963). (In Russian)

The DNA-ase II activity was studied in the mitochondria and supernatant liquid of the liver and spleen. In the spleen DNA-ase II was most active. In experiments in vitro and in vivo x irradiation increased the DNA-ase II activity in the supernatant liquid of the spleen. The anaerobic irradiation of the mitochondria suspension insignificantly pre-

vented an increase in DNA-ase activity of the supernatant liquid of the spleen. (auth)

43290 RADIATION GENETICS OF THE RHESUS MONKEY, MACACA MULATTA. III. THE EFFECT OF DIFFERENT DOSAGES OF γ-IRRADIATION ON THE SPERMATOGONIA AND SPERMATOCYTES OF M. MULATTA. C. C. Tan, S. Y. Chao, C. S. Chang, and T. T. Liu (Futan Univ., Shanghai). Sci. Sinica (Peking), 13: 1447-52(Sept. 1964).

The results are presented of observations on the quantitative changes in number and division abnormalities of spermatogonia and spermatocytes of Macaca mulatta following local irradiation of testis by ^{60}Co gamma rays at the respective dosages of 10, 25, 50, 100, 150, 200, 300, and 400 R-units. The observations were all made 10 days after irradiation. The dosage-effect curves obtained show that the LD_{50} for spermatogonial cells lies between 50 and 100 R, while that for spermatocytes is about 100 R. The frequency of Sertoli cells rises with the increase of dosage, whereas the diameter of cross-sections of seminiferous tubules diminishes gradually. The results suggest that appropriately low dosages of irradiation may produce a stimulating effect on the spermatogonial divisions. (auth)

43291 STUDY OF QUANTITATIVE CHARACTERS OF AN EARLY-FLOWERING MUTANT OF WINTER PADDY. A. K. Roy Choudhury (Bose Inst., Calcutta). Trans. Bose Res. Inst. (Calcutta), 25: 165-71(Dec. 1962).

An early-flowering mutant isolated from P_2 generation of aman (winter) paddy continued to show its earliness in flowering for two years successively. Besides its greater range of vibration in flowering, the mutant was found to be less sensitive to photoperiod effect than the control. It is suggested that the gene responsible for photoperiod sensitiveness was partially mutated to a photoperiod insensitive condition. Though the mutant flowered earlier than the control, it was associated with poorer number of tillers and of panicles and lower yields of grain and straw. Twelve selections were made from the mutant and they did not differ from one another with regard to the quantitative characters that were studied. (auth)

43292 RADIATION-INDUCED ABERRANT PLANT GROWTH IN JUTE. II. THE LEAF ABNORMALITIES. Rabindra Krishna Basu (Bose Inst., Calcutta). Trans. Bose Res. Inst. (Calcutta), 25: 199-218(Dec. 1962).

The early growth of five varieties of jute seedlings, grown following treatments of their seeds with x rays and beta rays from ^{32}P and ^{35}S, was characterized by development of various kinds of leaf abnormalities, which included, mainly: change in shape and size; change in margin and apex; distorted venation; fission and fusion of leaves to various depths; irregular development of wings; irregular development of chlorophyll and thereby giving a mosaic-like appearance; development of funnel or cup-shaped leaves (ascidia); and development of crinkled leaves. The development of abnormal leaves was very much pronounced in the treated seedlings particularly where the initial growth was disturbed than in the plants in the same treated population which otherwise had normal growth. The abnormal leaves appeared on the first four to eight nodes and excepting in the case of crinkled leaves all other abnormal leaves grew only to their maturity and once these leaves dropped off the later growth was normal without recurrence of any of these abnormalities. The effectiveness of the three mutagens in the induction of leaf abnormalities varied considerably. Treatments with ^{35}S produced very few plants with abnormalities compared to treatments with x rays and ^{32}P beta rays. Basing on the frequency of plants with abnormal leaves, the effectiveness of the three mutagens may be written as ^{32}P > x rays > ^{35}S. The frequency of plants with abnormal leaves was more in the three varieties of C. olitorius than in the two varieties of C. capsularis. Unlike the first generation plants, leaf abnormalities in the second generation were restricted to two categories: forking of lamina and crinkled leaf. The experimental results indicate that the radiation induced leaf abnormalities in jute have no genetic bearing. The probable mechanisms for the formation of such leaves have been considered to be due to disturbances in the production and/or distribution of growth substances, breakdown of phosphate metabolism, accumulation of free amino acids and chromosomal abnormalities. (auth)

43293 TRANSPLANTATION STUDIES OF STRONG AND WEAK HISTOCOMPATIBILITY BARRIERS IN MICE. II. TOLERANCE. Charles F. McKhann (Karolinski Institutet, Stockholm). Transplantation, 2: 620-6(Sept. 1964).

Using coisogenic strains of mice, differing only by weak histocompatibility factors, long-lasting tolerance was induced in adult animals by the injection of spleen cells. The interrelationship between tolerance and immunity was explored and a theory proposed based upon the induction or selection of preimmune host lymphoid cells that have some degree of specificity for the antigen. It is suggested that these cells, representing an early step in the direction of immunity, are vulnerable to suppression or destruction by excessive doses of antigen. (auth)

43294 A COMPLICATION FOLLOWING CEREBRAL ANGIOGRAPHY WITH THOROTRAST. H. Bruck, F. Gerstenbrand, T. Mueller, and K. Weingarten (Universität, Vienna). Wien. Z. Inn. Med. Grenzg., 44: 497-503(1963).

Damage due to x ray diagnosis and ionizing radiation is discussed. The physico-chemical and biological properties of thorotrast are mentioned and the risks resulting from its diagnostic use are pointed out. A report is given on a patient who developed a granuloma of the left neck 15 yr after bilateral surgical carotid angiography with this contrast medium. Besides the local granuloma with damage to the 9th and 10th nerves and the sympathetic plexus the patient also had signs of storage of the contrast medium in the spleen and lymph nodes. During observation for 2 yr the damage progressed and the last follow-up examination showed signs of incipient hepatic damage. A brief review is given of some cases reported in the literature and the recommendation is made to follow-up continuously all patients who have been examined with thorotrast and have a local granuloma or storage of the contrast medium, since progressive damage or malignant tumors are to be expected. (Excerpta Med., Sect. XXIII, 1: (Sept. 1964))

43295 DOMINANT LETHAL MUTATIONS IN TOTAL AND PARTIAL X IRRADIATION OF THE MALE MOUSE. Otto Hug (Universität, Munich and Institut für Strahlenschutzforschung der Gesellschaft fur Kernforschung, Munich). Z. Naturforsch., 19b: 541-3(June 1964). (In German)

A comparison was made of the mutagenic effects of whole-body and partial-body irradiation on the germ cells of the mouse. Male mice of the 101 and C3H strain, aged 10 to 12 weeks, were exposed to whole-body x irradiation, or irradiation in the gonad region only, at doses of 600 R for the whole-body exposure and 665 R for the gonad region. The males and unirradiated controls were mated with nonirradiated females of the same age and 13.5 to 16.5 days after conception the number of gravid females,

corpora lutea, and living and total fetuses were determined. The results are tabulated and discussed. (J.S.R.)

43296 RADIATION EFFECTS AND THE ADRENAL CORTEX. I. CHANGES IN CORTICOID CONTENT OF THE ADRENALS IN WHOLE-BODY IRRADIATED RATS. Kurt Flemming and Muenip Yegin (Heiligenberg-Instituts, Ger. and Universität, Freiburg i. B.). Z. Naturforsch., 19b: 745-50(Aug. 1964). (In German)

In rats, after a lethal whole-body x-irradiation of 1000 R, a severe weight loss, an increase in the suprarenal capsule, and a corticoid increase in the adrenal tissue were observed. Two periods were distinguished in the changes of the corticoid content of the adrenals after irradiation. In the first period of 48 hr, there were multiple increases and decreases in the form of variations from the control value. In the second period of 3 days the corticoid content of the enlarged suprarenal capsule increased strongly; it amounted, in male animals on the sixth day after irradiation, to 93% of the control value, and in female animals on the seventh day after irradiation to 79%. The results showed that for lethally irradiated rats after three days the adrenal cortex activity increases and continues to increase until the death of the animal. These findings are compared with information in the literature and are discussed. (tr-auth)

43297 EFFECTS OF IONIZING RADIATION ON THE DIGESTIVE SYSTEM. Translated into English from Original Russian Text of I. T. Kurtsin. Amsterdam, Elsevier Publishing Company, 1963. 326p. 45 guilders.

The functional characteristics of the digestive organs after exposure to ionizing radiation, and mechanisms of impairment of their activity during radiation sickness are discussed. Functional characteristics examined are: salivation, gastric secretion, pancreatic secretion, the bile forming and bile secreting functions of the liver, intestinal secretion, intestinal absorption, gastrointestinal excretion, motility and evacuation and morphological changes in the digestive system following radiation injury. Mechanisms of impairment included are: impairment of the complex reflex mechanism, significance of functional weakening of the cerebral cortex in radiation injury to the digestive system, role of the blood vessels in secretory disorders, impairment of interoception in the gastrointestinal tract, impairment of humoral regulation of digestion and general conclusions on radiation injury to the digestive system (cortical-subcortical relationship, spontaneous secretion, impaired hormonal regulation etc.). (Occupational Safety Health Abstr., 2: No. 8, 1964)

43298 THE USE OF IONIZING RADIATION FOR THE GENETIC IMPROVEMENT OF HERBACEOUS PLANTS. Francesco d'Amato. p.25-43 of "Progresso Agricolo e Scienze Nucleari." Florence, Officine Grafiche Vallecchi, 1963. (RT/BIO(63)38). (In Italian)

A bibliographic review is made of the studies on radio-induced genetic improvement of herbaceous plants. The theoretical basis for genetic improvement is given, and the methods used and problems encountered in mutation induction are discussed. Some examples illustrate genetic improvement by induced mutation. 50 references. (J.S.R.)

Radiation Effects Therapy and Countermeasures

43299 CHEMICAL SENSITIZATION OF CLOSTRIDIUM BOTULINUM SPORES TO RADIATION IN MEAT. K. L. Krabbenhoft, D. A. Corlett, Jr., A. W. Anderson, and P. R. Elliker (Oregon State Univ., Corvallis). Appl. Microbiol., 12: 424-7(Sept. 1964).

Beef ground round inoculated with 1,000,000 spores of Clostridium botulinum 33-A per gram and containing various additives was exposed to gamma radiation. Spores were inactivated in samples (irradiated at 2.0, 2.5, and 3.0 Mrad) which contained sodium nitrate (1,000 ppm) plus sodium chloride (2.5%). Similar results were obtained when sodium nitrite (200 ppm) was substituted for sodium nitrate, except that there was evidence of spore survival in 1 of 120 cans irradiated at 2.0 Mrad. Spore destruction was based upon the absence of spores and mouse-lethal toxin in meat subcultures made from cans incubated at 35°C for 120 days. Spores were not destroyed when exposed to 2.5 or 3.0 Mrad in the absence of sodium nitrate, sodium nitrite, or sodium chloride. Furthermore, the use of these chemicals individually, together with radiation, was ineffective. The additives alone in the absence of radiation also did not cause spore destruction. Radiation levels of 2.0, 2.5, and 3.0 Mrad, when used with sodium chloride at 1.5 or 2.0% and sodium nitrate at 500 ppm or sodium nitrite at 100 ppm, were ineffective. (auth)

43300 RADIOPROTECTIVE EFFECTS OF THE NEWER PSYCHOTROPIC DRUGS. A. Locker and H. Ellegast (Universität, Vienna). Experientia, 20: 389(1964). (In German)

Three psychotropic drugs Valium, Tryptizol, and Insidon protect mice against lethal irradiation when administered 15 min before irradiation. Survival increases significantly from 0% in the controls to about 30% in the pretreated animals. When the animals are irradiated at the time of maximum depression of whole-body metabolism (i.e., 90 min after injection) after administration of Taractan, the survival rate further increases from 42 to 73% and becomes highly significant. (auth)

43301 PROTECTION OF VICIA FABA EQUINA AGAINST X-RAYS BY SEROTONIN. H. Lozeron, A. Maggiora, and W. Jadassohn (Hôpital Cantonal, Geneva). Experientia, 20: 390-1(1964).

Increasing doses of x rays (200, 250, 300, 350, and 400 R) reduced the appearance and growth of accessory roots in Vicia faba in proportion to the x-ray dose used. 400 R completely inhibits the appearance of accessory roots. The protective effect of cysteamine was confirmed, and that of serotonin was demonstrated. (J.S.R.)

43302 COMPARATIVE STUDY OF THE EFFECT OF ANTIBIOTICS, BONE MARROW AND CYSTEAMINE ON ORAL LESIONS PRODUCED IN HAMSTERS BY TOTAL BODY IRRADIATION. J. Mayo, F. A. Carranza, Jr., and R. L. Cabrini (Universidad, Buenos Aires). Experientia, 20: 403-4(1964).

The effect of antibiotics, homologous bone marrow, and cysteamine on the development of the necrotic ulcers produced in the mouth of Mesocricetus aureatus by whole-body irradiation was studied. It was shown that bacterial factors play a significant role in the lesions studied. (tr-auth)

43303 AMINO ACIDS AS PROTECTIVE COMPOUNDS IN ULTRAVIOLET-IRRADIATED HANSENULA WINGEI. D. E. Hunt (Charles V. Chapin Hospital, Providence). J. Bacteriol., 88: 893-5(Oct. 1964).

Prefeeding Hansenula wingei with small concentrations of either tryptophan, cystine, tyrosine, phenylalanine, leucine, cysteine, threonine, isoleucine, ethionine, norvaline, or histidine protected this yeast against inactivating ultraviolet treatment. Prefeeding with methionine, proline,

or alanine conferred little if any protection, and valine or serine caused this organism to be more sensitive to ultraviolet inactivation. A direct relation exists between the concentration of the protective amino acids and the number of surviving cells. The heterocyclic and aromatic amino acids are generally more protective than the corresponding aliphatic compounds. The diversity of the compounds as well as quantitative differences in the protection afforded by them suggests that they have different modes of action. (auth)

43304 THE PRINCIPLES OF COLLATERAL MEDICAL THERAPY IN TREATMENT OF X IRRADIATED PATIENTS. F. Bistolfi and A. M. Podesta (Università, Genoa). Minerva Radiol., Fisioterap. Radiobiol., 9: 47-8(Jan.-Feb. 1964). (In Italian)

The principles of collateral medical therapy usually followed at the Repart Roentgenterapico of the Istituto di Radiologia are reported. Treatment methods for cutaneous reactions, mucous reactions, edema, sclerosis, ulceration, and radiation sickness are briefly described. (J.S.R.)

43305 RADIOPROTECTIVE EFFECTS OF NEW ORGANIC THIOLS. F. Cugurra and E. Balestra (Università, Genoa). Minerva Radiol., Fisioterap. Radiobiol., 9: 48 (Jan.-Feb. 1964). (In Italian)

The radioprotective effects of meso-dithiosuccinic acid and d,l-dithiosuccinic acid were studied in guinea pigs exposed to 600 R x radiation. The meta acid gave the better therapeutic results. However, the d,l isomer was more active in a prophylactic sense. (J.S.R.)

43306 A COMPARISON OF EFFECTS OF SOME CHEMOTHERAPEUTIC AGENTS AND THOSE OF X-RAYS ON THE REPRODUCTIVE CAPACITY OF MAMMALIAN CELLS. Roger J. Berry (Churchill Hospital, Oxford). Nature, 203: 1150-3(Sept. 12, 1964).

Dose-response relations for the reproductive capacity of HeLa and L cells exposed in vitro to several commonly used anticancer drugs are reported, and these relations are compared with those for x-irradiation of the same cells. The drugs tested were: nitrogen mustard, ethylenimine, epoxide, 5-fluoruracil, HN_3, and mannitol mustard. Nitrogen mustard, ethylenimine, and HN_3 were found to produce dose-response curves of the x-ray type Mannitol mustard produced a poison-type curve and was thus clearly not radiomimetic at the cellular level. The continuous presence of 5-fluoruracil produced a catastrophic dose-response curve with minute increments in dose, producing vast decreases in cell survival once the threshold dose was exceeded. (H.M.G.)

43307 INHIBITION OF TUMOUR GROWTH IN IRRADIATED MICE BY SENSITIZED HOMOLOGOUS SPLEEN CELLS. P. S. Gardner (Royal Victoria Infirmary, Newcastle upon Tyne, Eng.), C. A. H. Trench, C. A. Green, and T. Bird. Nature, 203: 1295(Sept. 19, 1964).

The effect of homologous immune spleen cells on the same mouse tumor was investigated in animals: irradiated and injected intraperitoneally with tumors three days later, followed one hr later by inoculations of homologous immune spleen cells irradiated and intraperitoneally inoculated with tumors five days later; and not irradiated but injected intraperitoneally with tumors at times corresponding to tumor injections in the other two groups. The mean survival time in each of the three groups of mice was essentially the same. Although mice injected with tumors five days after irradiation and those not irradiated prior to tumor injection developed marked ascites and solid tumor in the peritoneal cavity and histological evidence of extensive tumor infiltration of other organs; the mice treated with immune spleen cells showed no ascites, solid tumors, or histological evidence of tumor or infiltration. (H.M.G.)

43308 RECOVERY OF REPRODUCTIVE ABILITY BY HOMOLOGOUS TESTES-DNA OF RATS IRRADIATED DURING THE INFANTILE PERIOD. N. Savkovic (Inst. of Nuclear Sciences "Boris Kidrich," Belgrade). Nature, 203: 1297-8(Sept. 19, 1964).

Work was done to find whether homologous testes-DNA of sexually mature rats affects the reproductive ability and the reproductive organs of sexually immature male rats irradiated with a dose of 600 R, and whether the functional disturbances of the reproductive organs induced by irradiation can be recovered by applying homologous testes-DNA. Results showed that with native testes-DNA it was possible to repair the morphological-cytological constitution and functions of the reproductive organs in male rats irradiated in the infantile period. (H.M.G.)

43309 THE PROTECTIVE ACTION OF VITAMIN A UPON THE MOUSE EPITHELIUM IN COURSE OF IRRADIATION. Bogumila Szymczyk. Polski Przeglad Radiol. i Med. Nuklearnej, 28: 369-76(1964). (In Polish)

Many substances exert protective action upon the organism exposed to the x rays. Among such substances there are the hormones and certain vitamins. Experiments were performed as to the protective action of the vitamin A upon the epithelium of white mice exposed to irradiation. The results support the protective role of the mentioned vitamin on the superficial as well as on the deeper layers of the epithelium. These observations permit further studies on the role of the vitamin A in man, especially in cases of local irradiations. (auth)

43310 THE MECHANISM OF CHEMICAL PROTECTION AGAINST IONIZING RADIATION. I. PROTECTIVE EFFECT OF SULFUR ATOM- AND AMINO GROUP- CONTAINING COMPOUNDS ON RADIATION DEGRADATION OF METHYLENE BLUE. Shigetoshi Antoku (Hiroshima Univ.). Proc. Res. Inst. Nucl. Med. Biol. (Japan), No. 5, 58-63(1964).

The protective effect of sulfur- and amino group-containing compounds on radiation degradation of methylene blue was studied. Percent remaining fraction in methylene blue only, and methylene blue added protective agents was linear to the logarithm of dose. Compounds such as thiourea and thiosemicarbasite which contain both sulfur atom and amino group were the most effective, and compounds which do not contain sulfur atom were less effective. The sulfur atom was about five times more effective than C or O and the amino group was about 1.3 times more effective than methyl group. Comparing the protective effect in mammals at cellular levels and molecular levels showed that the mechanism of protection in three systems differed slightly from one another. (auth)

43311 THE MECHANISM OF CHEMICAL PROTECTION AGAINST IONIZING RADIATION. II. DISTRIBUTION OF S^{35}-MEG IN VARIOUS TISSUES IN MICE INJECTED WITH S^{35}-MEG. Shigetoshi Antoku (Hiroshima Univ.). Proc. Res. Inst. Nucl. Med. Biol. (Japan), No. 5, 64-75(1964).

The distribution of total ^{35}S (MEG), free ^{35}S (MEG) and binding ^{35}S (MEG) in various tissues of adult female mice (ddN uniform strain) administered as a protective dose of ^{35}S-MEG was studied. Total ^{35}S-MEG reached a peak

within 5 minutes in blood, liver and spleen, at 10 minutes in kidney, at 20 minutes in small intestine, lung and thymus and at 30 minutes in bone marrow. Changes in free ^{35}S and bound ^{35}S contents in tissues with time after injection of ^{35}S-MEG were essentially the same in character to that of total ^{35}S. Although a considerable correlation was observed between protective effect and total ^{35}S of all organs examined, it was not linear. Four metabolized compounds were observed in organs of mice injected with ^{35}S-MEG by paper chromatographic method. (auth)

43312 THE MECHANISM OF CHEMICAL PROTECTION AGAINST IONIZING RADIATION. III. SULFHYDRYL CONTENTS IN VARIOUS TISSUES OF MICE INJECTED WITH MERCAPTOETHYLGUANIDINE. Shigetoshi Antoku (Hiroshima Univ.). Proc. Res. Inst. Nucl. Med. Biol. (Japan), No. 5, 76-9(1964).

Sulfhydryl content in tissues of mice injected with MEG was determined by nitroprusside method and the following results were obtained. The sulfhydryl content in the liver and spleen gradually decreased with lapse of time after injection of MEG. The content in the kidney reached a peak at 10 minutes, and in the small intestine and lung at 20 minutes. The change of sulfhydryl content with time after injection of MEG was similar to that of total ^{35}S, free ^{35}S, and binding ^{35}S after injection of ^{35}S-labeled MEG. (auth)

43313 EXPERIMENTAL STUDIES ON THE RESTORATIVE EFFECTS OF THE VARIOUS PHYSICAL STIMULANTS AGAINST X-IRRADIATION INJURIES. Shigeru Iwamori, Nobuo Nagata, Yukuo Imada, Junichi Tanimoto, Ichiro Ishihara, Yoshio Imanishi, Hideaki Matsumura, and Tsunenori Nakamae (Hiroshima Univ.). Proc. Res. Inst. Nucl. Med. Biol. (Japan), No. 5, 127-34(1964). (In Japanese)

The therapeutic values of various physical stimulants against irradiation injury were studied. Mice of ddN strain, weighing 20 grams, were classified into following two irradiation groups: acute injury group whole-body irradiated with 500 R of x rays and chronic injury group repeatedly irradiated with 60 R of x ray 15 times daily. Various agents were administrated daily: androgen, estrogen, Solcoseryl, photosensitized dye, ipsilon-aminocaproic acid, polyvaccine lymph, and gamma-globulin. Controls were given normal saline. Treatment started simultaneously with irradiation. Changes of body weight, survival rate, leucocyte counts and histological effect were compared among each subgroup for 30 days. Especially, continuous administration of PVL is effective for regeneration of depleted bone marrow. Generally, remarkable restorative effect against x-irradiation injury was observed in mice treated with androgen and polyvaccine lymph. (auth)

43314 ANTIBIOTIC THERAPY AFTER EXPOSURE TO X-RAYS. Walter Krasavage and Sol M. Michaelson (Univ. of Rochester, N. Y.). Radiation Res., 23: 167-79(Oct. 1964).

Seventy-eight beagles were randomly divided into thirteen groups of 6 animals each to compare the response of animals treated with different antibiotics after irradiation. The radiation was 1000-kvp x rays, and the antibiotics used were chloramphenicol and penicillin–streptomycin. Body weight, rectal temperature, hematological response, and lethality were the parameters of interest. Radioiron (^{59}Fe) was injected preirradiation and on the fourteenth day postirradiation to study the plasma iron clearance, whole blood, plasma, and red blood cell volume. At the lower dose level ($LD_{10(60)}$) there were no significant differences in lethality. At the median dose level ($LD_{65(60)}$) the irradiated controls showed an 83% lethality, whereas those receiving penicillin–streptomycin or chloramphenicol after exposure showed a 67% or 17% lethality, respectively. At the higher dose level ($LD_{95(60)}$) a significant difference was seen between the group that received penicillin–streptomycin (50% lethality) and the group that received chloramphenicol (100% lethality). Body weight, temperature, and hematological response differed only between the survivors and nonsurvivors, regardless of irradiation dose and antibiotic. Plasma iron clearance half-time and red blood cell volume changes showed a dose-dependent response, and plasma volume response exhibited interesting trends. (auth)

43315 HEMATOPOIETIC RECOVERY IN ENDOTOXIN-TREATED LETHALLY X-IRRADIATED BUB MICE. Alice M. Savage (Brown Univ., Providence). Radiation Res., 23: 180-91(Oct. 1964).

Mice exposed to 750 R of whole-body x irradiation undergo severe damage to hematopoietic tissues resulting in massive cellular destruction and depletion. Little cellular restoration occurs, and the animals usually die within 12 days. Cellular depletion of hematopoietic tissues in mice treated with 3 μg of Proteus morganii endotoxin prior to irradiation was similar to that in the irradiated control animals. Hematopoietic regeneration was evident 5 days after irradiation, however, and became widespread in the bone marrow and spleen during the second week. Restoration of hematopoietic cells was dependent on reticular cell transformation into hematopoietic stem cells, division and differentiation of hemocytoblasts, and repeated division of immature blood cells. (auth)

43316 SELENOAMINO ACIDS AS RADIATION PROTECTORS IN VITRO. F. Shimazu and A. L. Tappel (Univ. of California, Davis). Radiation Res., 23: 210-17(Oct. 1964).

The possibility that the selenoamino acids selenomethionine and selenocystine function as radiation protectors was tested in amino acid and protein model systems. Results show that selenoamino acids are more powerful radiation protectors than the analogous sulfur amino acids and other known—SH protectors. Free radical scavenger and repair mechanisms by which selenomethionine reacts as a protector through ionization, abstraction, and displacement reactions are discussed. (auth)

43317 THE TREATMENT OF RADIATION INJURY IN LETHALLY IRRADIATED RANDOM-BRED MICE BY INTRAVENOUS INFUSION OF MARROW FROM A POOL OF DONORS. Š. Vlahović, V. Vlahović, and J. W. Ferrebee (Mary Imogene Bassett Hospital, Cooperstown, N. Y.). Transplantation, 2: 644-8(Sept. 1964).

In a randombred population of Swiss-Webster mice a study was made of survival rates following lethal exposure to radiation, 750 R. When antibiotics were given, infusions of marrow from a pool of 30 to 60 donors were as effective in inducing survival as infusions of autologous marrow. Survival was less good when the marrow infusions came from a single donor, or from a pool of 15 donors, or from a pool of 120 donors, irrespective of the numbers of cells injected. The implication of these observations and the probable usefulness and limitations of marrow from pools of donors are discussed on the basis of H-2 heterogenicity known to exist in the population. (auth)

Radiation Hazards and Protection

43318 (IDO-12038) COMPARISON OF EXCRETION ANALYSIS WITH WHOLE-BODY COUNTING FOR AS-

SESSMENT OF INTERNAL RADIOACTIVE CONTAMINANTS. Claude W. Sill, Jesse I. Anderson, and Donald R. Percival (Idaho Operations Office. Health and Safety Div., AEC). Mar. 1964. 14p. (CONF-448-34)

From IAEA Symposium of the Assessment of Radioactive Body Burdens in Man, Heidelberg, Ger., May 1964.

The in vivo whole-body counting program demonstrated clearly that urinalysis is grossly inadequate as a general monitoring technique for internal contaminants. Thirty-one different radionuclides were encountered in human subjects by whole-body counting of which only ^{131}I, ^{132}I, ^{133}I, ^{134}Cs, ^{135}Cs, ^{136}Cs, ^{137}Cs, ^{197}Hg, ^{198}Hg, ^{199}Hg, ^{200}Hg, ^{201}Hg, ^{202}Hg, ^{203}Hg, ^{99}Mo, and ^{99}Tc were excreted significantly in the urine. The other nuclides were eliminated so exclusively in the feces that, except for an occasional trace, the nuclide could not be detected even in a 1500-ml urine sample. For inhaled particulates, the metabolic fate was found to be more dependent on the physical properties of the particle with which the nuclide is associated than with the chemical properties of the element itself. The effective half lives and modes of excretion are presented for many of the nuclides encountered. An instrument is described in which the heavy shielding normally associated with whole-body counters is eliminated to achieve portability and reasonable costs. (C.H.)

43319 (LA-3132-MS(p.170-9)) CESIUM CALIBRATION COMMITTEE. P. N. Dean (Los Alamos Scientific Lab., N. Mex.).

A Committee on Intercomparison of Human Cesium-137 measurements was formed in Sept. 1962. The objective of this committee is to establish and implement methods of intercalibration of the various laboratories measuring human ^{137}Cs body burdens. Procedures for use in the cesium calibration program are outlined. (C.H.)

43320 (ORNL-P-322) CALCULATED TISSUE FLUX-TO-DOSE CONVERSION FACTORS FOR NUCLEONS OF ENERGY BELOW 400 Mev. W. E. Kinney and C. D. Zerby (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 5p. (CONF-720-1)

From 2nd Symposium on Protection Against Radiation Hazards in Space, Gatlinburg, Tenn., Oct. 1964.

A series of calculations was performed to supply tissue flux-to-dose conversion factors for incident neutrons and protons having energies in the range from 60 to 400 Mev. A general set of factors was computed, which may be applied to specific radiation fields to give upper and lower bounds on the surface, 5-cm depth, average, and maximum doses. The model chosen for study was a 30-cm-thick slab of tissue infinite in its lateral dimensions. The calculations were performed by means of a series of Monte Carlo computer codes. Nucleons were effectively introduced uniformly over one face of the slab both normally and isotropically to give doses which should bracket those resulting from actual angular distributions. The doses were computed by summing the energy deposited in unit cubes distributed through the slab in a direction normal to the surface. (C.H.)

43321 (ORNL-P-350) THE NEED FOR RESEARCH PROGRAMS TO PROVIDE DATA APPLICABLE TO THE ESTIMATE OF MAXIMUM PERMISSIBLE EXPOSURE VALUES FOR INTERNALLY DEPOSITED RADIONUCLIDES. Karl Z. Morgan (Oak Ridge National Lab., Tenn.). Aug. 21, 1964. Contract W-7405-eng-26. 20p. (CONF-713-1)

From 4th Inter-American Conference on Toxicology and Occupational Medicine, Miami Beach, Fla., Aug. 1964.

Much was learned about the hazards associated with ionizing radiation and maximum permissible exposure levels for the radionuclides were established with great reliability and confidence, but there still remains a considerable uncertainty in many of the basic assumptions and in the parameters used in the calculation of maximum permissible body burden and maximum permissible concentration of the various radionuclides in food, water, and air. There is considered to be a need to determine the uptake, distribution, and elimination of a variety of chemical compounds of the approximately 300 common radionuclides. These data are needed for the several modes of intake by the various age groups, and differences due to race, sex, weight, eating habits, etc., should be investigated. There is need especially to obtain data from studies of human exposure and to examine the influence of the quality and chemical form of the radionuclide and of other associated chemical elements taken into the body, both from single exposure and from continuous exposure. (M.C.G.)

43322 (RFP-431) EFFECTIVENESS OF EARLY DTPA TREATMENTS IN TWO TYPES OF PLUTONIUM EXPOSURES IN HUMANS. C. R. Lagerquist, S. E. Hammond, E. A. Putzier, and C. W. Piltingsrud (Dow Chemical Co. Rocky Flats Div., Golden, Colo.). Sept. 2, 1964. (CONF-727-1)

From 10th Annual Bioassay and Analytical Chemistry Meeting, Cincinnati, Oct. 1964.

Two cases of plutonium exposure are reported. Both cases were given prompt DTPA (diethylenetriaminepentaacetic acid) treatments. In one case, an employee was sprayed with a plutonium nitrate solution. Plutonium entered his body via ingestion, inhalation, and absorption through small acid burns on the skin. In the other case, an employee's thumb was pierced by a wire contaminated with plutonium oxide. The plutonium levels in their urine, feces, and blood were measured regularly. The effectiveness of the DTPA treatments was markedly different in the two cases. The DTPA was very successful in removing the soluble plutonium in the first case, however, the effectiveness of the treatment was inconclusive in the second case. (C.H.)

43323 (JPRS-26574) INDIVIDUAL MEANS OF PROTECTION AGAINST CHEMICALS AND RADIATION. V. A. Alkhazov and A. P. Tkachev. Translation of "Individual'nyye Sredstva Protivokhimicheskoy i Protivoradiatsionnoy Zashchity" (a publication of the State Atomic Publishing House, Moscow, 1964). 52p. (TT-64-41832)

The protection of individuals against radiological and chemical warfare agents is discussed with emphasis on the protection of respiratory organs and the skin. The design and effectiveness of various types of gas masks, respirators, and protective clothing are reviewed. (C.H.)

43324 EXPERIMENTAL THERAPY TEST WITH HETEROLOGOUS FREEZE-DRIED BONE MARROW CELLS IN RADIATION SYNDROME AFTER SINGLE WHOLE-BODY IRRADIATION. H. Kleinsorge and W. May (Universität, Jena, Ger.). Deut. Gesundheitsw., 18: 320-3(1963). (In German)

The therapeutic effects of dry cells from fetal sheep bone marrow on mice irradiated with 800 R x radiation were investigated. The study was unsuccessful. It was assumed that the difference in genetic relationship between donor and receiver was too great. (tr-auth)

43325 PREVENTION AND TREATMENT OF ACUTE RADIATION SICKNESS IN DOGS WITH THE AID OF SODIUM GALLATE. A. A. Gorodetskii and V. A. Baraboi

(Inst. of Physiology, Kiev). Fiziol. Zh., Akad. Nauk Ukr. RSR, 9: (240-?). (In Ukrainian)

It was previously found that gallic acid derivatives, especially Na, propyl, and butyl gallates, exert a marked protective action against radiation sickness in small animals. In order to be able to apply these findings for the protection of humans exposed to radiation, experiments were carried with larger animals. Short-haired dogs were used for the tests, during which the animals were exposed to a lethal dose of 600 R x radiation. The protective agent, Na gallate, was injected intravenously in physiological solution. The dogs were weighed daily and their temperature was taken at regular intervals, at which time their blood was examined. The untreated animals survived the exposure an average of 11.6 days; treatment with Na gallate at the rate of 200 or 300 mg/kg weight resulted in a prolongation of the survival period to an average of 17.6 days. The morphological picture of the peripheral blood of the irradiated animals did not differ markedly from that of the control animals. Before death, the hematologic index, especially the number of leucocytes decreased markedly, reaching values of 500 or even 200 cells per 1 mm^3 of blood; the lymphocytes disappeared completely. (TTT)

43326 PROTON PENETRATION OF SPACE SUIT MATERIALS. W. E. Dance, D. L. Edens, B. J. Farmer, and J. H. Johnson (Ling-Temco-Vought Research Center, Dallas). Health Phys., 10: 809-16(Nov. 1964).

The potential hazard to astronauts due to penetration of space suit materials by high energy protons has been investigated. Materials comprising a pressure suit of the type used in the Mercury space capsules were bombarded by 10.72-Mev protons from the reaction $^{10}B(d,p)^{11}B$ using a 3.0-Mev Van de Graaff accelerator. Analysis of proton spectra after penetration of all five layers of the space suit indicates that the inhomogeneity of the materials makes accurate calculation of the proton absorption using a mean thickness for the space suit impossible. Although the measured average surface density of the space suit is sufficient to stop all the 10.72-Mev protons in a homogeneous material, inhomogeneity permitted 80 per cent of the protons to pass completely through the unit. Energy losses of the protons through the materials were measured by using a scintillation spectrometer to analyze the proton spectra before and after penetration of the materials. From the energy distribution after penetration of the suit the inhomogeneity in terms of the thickness distribution for the material was established. The proton transmission curve for the 10.72-Mev group indicates that 9.75-Mev protons have a 50 per cent probability of being absorbed in the suit, while at 6.3-Mev, less than 1 per cent transmission was obtained. A method has been outlined, using the experimental proton energy distribution and the known energy loss (dE/dX) curves for computing the attenuation of any other proton spectra through the material. (auth)

43327 RADIOPROTECTIVE EFFECTS OF PARAFFIN OIL. A. Locker and H. Ellegast (Universität, Vienna). Naturwissenschaften, 51: 385-6(1964). (SGAE-BL-8/1964). (In German)

The radioprotective effects of paraffin oil were studied on male mice injected i.p. ¼ hr and 1, 2, and 3 days before exposure to a single lethal dose of x radiation at 800 R. The survival of the treated animals was significantly higher in all cases with the exception of the treatment on the day of irradiation. There was a characteristic relation between the percent survival and the day of treatment. (J.S.R.)

43328 STRONTIUM-90 IN CHILDREN. H. T. Blumenthal. Scientist Citizen, 6: Nos. 9-10, 3-7(Sept.-Oct. 1964).

Information concerning the changes in ^{90}Sr content of deciduous teeth since 1951 is reviewed, and the relation of such changes to the amount of ^{90}Sr in the diet is shown. Data indicate that there was a progressive rise in the ^{90}Sr content of incisor crowns, and hence a comparative rise in bone of one-year-old infants to over 30 times that present in these structures in 1951. It is suggested that if testing had continued through the period 1963 to 1965 at the same rate and magnitude as in 1962, there would have been a 100 fold increase. Assuming a linear dose relation between the incidence of malignant tumors and the level of radioactivity, the frequency of bone-cancer-induction by ^{90}Sr is estimated from known levels of the isotope in deciduous teeth. (H.M.G.)

43329 RADIOACTIVITY IN ARCTIC PEOPLES. Joes Alan Snow and Alvin W. Wolfe. Scientist Citizen, 6: Nos. 9-10, 26-33(Sept.-Oct. 1964).

Reasons for the exceptionally high ^{137}Cs levels in Arctic people are discussed. It is concluded that unless the food chain is altered, dosage levels will continue to be high. Data indicate that at least two fallout constituents (^{90}Sr and ^{137}Cs) should well exceed the suggested maximum levels over the next few years. A complete evaluation of the total exposure of people living in Arctic regions is recommended. (H.M.G.)

43330 ZAKLADY RENTGENOWSKIE — WYMAGANIA OCHRONY PRZED PROMIENIOWANIEM JONIZUJACYM. PN-62 J-80101. (X-ray Laboratories — Regulations for Protection Against Ionizing Radiation). Warsaw, Polish Standards Committee, 1962. 4p. 2.40 Zloty.

This Polish standard regulation refers particularly to the planning and design of x-ray laboratories for 25 to 400 kv equipment for medical, industrial, scientific and other purposes. It contains regulations regarding the following: the factors to be considered when planning x-ray laboratories; the requirements to be met by such laboratories (for diagnostic and therapeutic purposes, non-destructive materials testing, scientific research, etc.); and conditions for approving projects and completed laboratories. (Occupational Safety Health Abstr., 2: No. 7, 1964)

43331 DOSE DELIVERED TO AN ORGAN FOLLOWING AN EXPOSURE OF SHORT DURATION IN A CONTAMINATED ATMOSPHERE. M. G. Vacca. 11p. (CONF-337-40)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

When an individual accidentally remains in a contaminated atmosphere, it is useful to determine the dose delivered to one or several of his organs. Two cases are considered for exposure of the order of several seconds or of the order of several hours. In both cases it is possible to evaluate the dose delivered as a function of the maximum permissible concentrations. For an exposure of several seconds, the dose expressed in rems, delivered in 50 years, is given by the relation $D = 2.5 \times 10^{-6} \times P/U$ (DMA)/(CMA) air, where X (in seconds) is the exposure time, P/U (Ci/m^3) is the contamination rate of the atmosphere at the moment of the accident, DMA(rem) is the weekly maximum permissible dose for the organ considered, CMA air (Ci/m^3) is the maximum permissible

concentration relative to the contaminating radioisotope. For an exposure of several hours, the dose D should be multiplied by a factor taking into account the duration of the exposure and the radioactive and biological periods. A rule was constructed that makes possible the determination of the dose delivered to an organ as a result of a quasi-instantaneous accidental absorption during any period of time. This rule is handled as an ordinary calculation and leads to results either from maximum permissible concentration or from basic data. (tr-auth)

Radiotherapy and Radiodiagnosis

43332 QUALITATIVE ANALYSIS OF ISODOSES IN MOVING TELECOBALT THERAPY. G. Zaccone (Ospedale Civile Galliera, Genoa). Atti, Congr. Nazl. Radiol. Med, Med. Nucl., 21: Bologna, 1960, 470-6(1961). (In Italian)

A method for the mathematical calculation of the γ dose on the axis and outside the axis in moving telecobalt therapy is reviewed. The method is based on the pattern of the dose in the rotation fulcrum by varying the thickness of interposed layers and the pattern of the dose along the perpendicular line of the beam axis or lateral decrease of the dose. (J.S.R.)

43333 THE USE OF RADIOACTIVE THULIUM 170 IN THE EXAMINATION OF VENTILATORY DISTURBANCES. C. Murczyński, H. Mikosza, S. Grec, M. Sypniewska, S. Tustanowski, and K. Naroznik. Gruzlica Choroby Pluc, 32: 107-17(1964).

Results of studies on the use of ^{170}Tm in ventilatory function tests and assessment of the function of each lung separately, showed that ^{170}Tm can be used for performing several tests of pulmonary function and of the left and right lung separately. The apparatus used consists of a radioactive thulium source of about 50 mC in lead casing with a collimator of 4.5 cm in. diameter, and a scintillation tube connected to an integrator. The permeability of the lungs for γ-irradiation from Tm on both sides is measured during deep inspiration and forced expiration. The measurements are done in 4 sites: 3, 6, 9, and 12 cm below the clavicle in the mid-clavicular line. The ratio of increment in frequency of impulses on the right lung in inspiration to the increment on both lungs multiplied by 100 gives the percentual respiratory function of the right lung. The same method of measurement applies for the left lung. The dose of irradiation for the examined patients is several thousandths of that during one x ray of the chest. Vital capacity-determined by spirometry allows calculation of the residual volume of each lung separately, based on the figures of the lung transparency and diameter of the chest. The point of reference in this calculation is transparency of the liver as an airless organ. Mathematical formulae for the calculations of residual volume are given. The thulium method can also be applied for the examination of respiratory reserve. (Excerpta Med., Sect. XXIII, 1: (Sept. 1964))

43334 EFFECTS OF THE CHRONOLOGICAL DISTRIBUTION OF DOSE ON RADIOSENSITIVITY. F. Bistolfi and N. Macarini (Universita, Genoa). J. Belge Radiol., 47: 490-508(1964). (In Italian)

The effects of the chronological distribution of dose on radiosensitivity are considered in a discussion limited to the two principal aspects of the time factor—continuous irradiation and fractionated irradiation. The concept of intensity limit in continuous irradiation and the processes of accumulation and recovery are defined and illustrated. Fractionated irradiation is considered on the basis of two principal factors: the magnitude of the single fractions and the interval separating them. The general applications of these concepts to radiotherapy are summarized. Data are included from studies on the biological effects of x radiation and radiation from internally deposited ^{131}I, ^{32}P, ^{198}Au, and ^{90}Y. (J.S.R.)

43335 RADIOSENSITIVITY FACTORS IN CANCER OF THE UTERINE CERVIX. J. Bonte, H. Van den Berghe, and P. Ide (Universite Catholique, Louvain, Belg.). J. Belge Radiol., 47: 509-10(1964). (In French)

The location of uterine cancer makes it accessible to external traumatic agents and offers advantages for investigation and radiotherapy. The configuration, volume, and pelvic extension of the cancer can be easily determined before, during, and after treatment. Repeated samplings are possible of the cancer itself and of the vaginal milieu. The determination of the caryotype of cancerous cells by direct examination and after tissue culture is an important element in the evaluation of the radiosensitivity of the cancer. (J.S.R.)

43336 RADIOPROTECTORS AND CANCER. J. R. Maisin, A. Léonard, and J. Hugon (Centre d'Etude de l'Energie Nucleaire, Mol, Belg.). J. Belge Radiol., 47: 511-12(1964). (In French)

A study of the distribution of ^{3}H-labeled AET in the tissue of normal and cancerous mice showed that AET penetrates in a diffuse fashion and without discrimination to all tissues (healthy or cancerous). In a given tissue nuclei and cytoplasm are labeled identically. Cytological and electron microscopic examinations show that AET interferes in some cellular reactions, but it could not be determined which are responsible for the radioprotective effect observed. AET protects both cancerous and healthy cells, but it significantly increases the survival rate of cancerous mice when it is coupled with irradiation. (J.S.R.)

43337 CONTRASTING INCIDENCE OF ACUTE MONOCYTIC AND GRANULOCYTIC LEUKEMIAS IN P^{32}-TREATED PATIENTS WITH POLYCYTHEMIA VERA AND CHRONIC LYMPHOCYTIC LEUKEMIA. Edwin E. Osgood (Univ. of Oregon, Portland). J. Lab. Clin. Med., 64: 560-73(Oct. 1964). (TID-20788)

Evidence is presented on the differing incidence of acute leukemia in two clearly defined populations treated with accurately measured intravenous doses of radioactive phosphorus and followed for a minimum of 8 years after the first dose. Data are summarized on 101 patients with polycythemia vera and 201 patients with chronic lymphatic leukemia treated with ^{32}P. Results indicate that there are factors other than ^{32}P which contributed to the high incidence of acute leukemia observed in these two populations. Evidence presented suggests that polycythemia vera is not a malignant condition. The incidence of acute leukemia in these two diseases is so different and so high, relative to a linear extrapolation of current estimates of radiation risk, that it suggests that risk of developing an acute leukemia is not a linear function of dose, and that different populations have widely different natural, and radiation, susceptibilities to somatic genetic change. While adequate base-line data on the incidence of acute leukemias in patients with chronic lymphocytic leukemia or polycythemia vera treated by other methods have not yet been published, it is well known that any of the other agents used in treating these diseases may also favor development of somatic genetic change and that, as yet, enough time has not elapsed to provide a sound basis for comparison of the

relative somatic genetic risk versus the relative ability to prolong productive survival time with these other agents. Random number studies are in progress to provide this information. It may require many years to accumulate enough patients, studied over a long enough period, to find definite answers. To date, these comparisons favor ^{32}P therapy over the other therapies studied. (auth)

43338 I^{131} THERAPY FOR HYPERTHYROIDISM: A PLEA FOR LESS CONSERVATISM IN COMPLICATED CASES. Joel I. Hamburger, George Kadian, Herbert W. Rossin, and Richard Sills (Northland Radioisotope Lab., Southfield, Mich.). J. Nucl. Med., 5: 675-80(Sept. 1964).

Where a prolonged hyperthyroid state would constitute a special hazard, consideration should be given to therapy with large doses of ^{131}I. A dose twice that usually employed is suggested for diffuse hyperthyroidism. In patients with autonomous hyperfunctioning nodules a dose adequate to deliver 15–20 mC ^{131}I to the nodule is employed. Post ^{131}I hypothyroidism, if anticipated and promptly treated, is a relatively minor therapeutic problem, causing only insignificant inconvenience and expense to the patient. Prolonged hyperthyroidism may be lethal in the elderly, the debilitated and the thyrocardiac. (auth)

43339 INTERSTITIAL IRRADIATION THERAPY WITH A SOLUTION OF Au^{198} AS PART OF COMBINATION THERAPY FOR PROSTATIC CARCINOMA. R. H. Flocks (Iowa State Univ., Iowa City). J. Nucl. Med., 5: 691-704(Sept. 1964).

A total series of 976 patients with prostatic cancer were given combinations of surgery plus interstitial instillation of ^{198}Au for destruction of the local lesion of prostatic cancer. The methods used for protection of personnel were satisfactory. The complications (anemia, leucopenia, damage to the adjacent organs, delayed wound healing) were very minimal when the principles underlying the technics of administration were adhered to. Significant improvement in the results of attempts to destroy the local lesions were obtained. This was in the order of magnitude of 55% cure as compared to 8% cure. (auth)

43340 POLAROID PHOTOSCANNING. R. W. Kyle and G. S. Johnston. J. Nucl. Med., 5: 705-8(Sept. 1964).

Approximately 200 thyroid photoscans were performed utilizing Polaroid film. These scans demonstrated the usefulness of the film in photoscanning. Dark room facilities were not required and the photoscan was available for interpretation 60 seconds after the scan was completed. With the addition of an enlarged radiographic packet, Polaroid film could be used instead of regular radiographic film for scanning all organs. However, the currently available film is adequate for most photoscanning. Through this Polaroid scanning method, photoscanning could be made more universally available as a diagnostic technique. (auth)

43341 VISUALIZATION OF A HYPERFUNCTIONING PARATHYROID ADENOMA USING Se^{75} SELENOMETHIONINE AND THE PHOTOSCANNER. Thomas P. Haynie, William K. Otte, and James C. Wright (Univ. of Texas, Galveston). J. Nucl. Med., 5: 709-13(Sept. 1964).

Scanning with ^{75}Se-selenomethionine is described for the case of a 50 year old woman with a hyperfunctioning parathyroid adenoma. The case demonstrates that sufficient concentration of ^{75}Se-selenomethionine may be achieved in a parathyroid adenoma to permit localization of the tumor using a photoscanner. Preparation of the patient with special diets or drugs was not required. (H.M.G.)

43342 DOSIMETRY IN COBALT THERAPY. III. ANALYTICAL STUDY OF KINETIC THERAPY DOSE BY ELECTRONIC COMPUTER AND COMPARISON WITH IONOMETRIC AND PHOTOGRAPHIC METHODS. G. Zaccone and F. Di Pietrantonj. Minerva Med., 1-2: 94-112 (Jan.-June 1961). (In Italian)

The principles of the method of calculation of the dose of γ radiation from a ^{60}Co teletherapy source at the center of rotation and outside the center of rotation were reviewed, and the final formula (as adapted for computer processing) was analyzed. The isodoses calculated for oscillations of 120, 180, 240, 300, and 360° were reported for source-focus distance of 55 cm. Ionometric and photographic dosimetry was used on phantoms to check the calculated isodoses. (J.S.R.)

43343 DOSIMETRY IN COBALT THERAPY. IV. SCHEME FOR TREATMENT OF UTERINE NEOPLASIA BY ECCENTRIC PENDULUM. G. Zaccone and F. Di Pietrantonj. Minerva Med., 7p.(1961). (In Italian)

The dosimetric study of the cobalt therapy of pelvic neoplasia is presented. The therapy plan obtained from the calculations was checked by ionometric measurements on water phantoms and patients. A method for the rapid calculation of the γ dose at the center of rotation, usable with the proposed therapeutic plan, is given. (tr-auth)

43344 EXPERIMENTAL INTRACAVITY DOSIMETRY IN THE COURSE OF TELECOBALT THERAPY OF UTERINE TUMORS. N. Macarini, G. L. Besio, and E. Gandolfo (Universitat, Genoa). Minerva Med., 53: 1318-21(May 2, 1962). (In Italian)

The techniques used in the treatment of uterine tumors are briefly described. The treatment consisted of preliminary endocavity radium therapy, telecobalt therapy, and medical therapy with antiblastic pharmaceuticals. Data on the amount of radiation received at the irradiation focus and by adjacent organs are reported. (J.S.R.)

43345 DOSIMETRY IN COBALT THERAPY. NOTE I. FIXED FIELDS WITH SOURCE-SKIN DISTANCE OF 58 CENTIMETERS. G. Zaccone and F. Di Pietrantonj (Istituto di Radiologia e Terapia Fisica degli Ospedali Galliera, Genoa). Minerva Med., 53: 1359-60(May 2, 1962). (In Italian)

The optimum conditions for the treatment of neoplasm of the thorax and breasts with fixed fields and with obliquely counterposed fields were studied. The cobalt-60 γ source was characterized by an opposed shield which limits the distance of irradiation. (tr-auth)

43346 DOSIMETRY IN COBALT THERAPY. NOTE II. DISTRIBUTION OF DOSE ON THORACIC WALLS IN POSTOPERATIVE TREATMENT OF MAMMARY NEOPLASIA WITH THORACIC TANGENTIAL FIXED FIELD. G. Zaccone and F. Di Pietrantonj (Istituto di Radiologia e Terapia Fisica degli Ospedali Galliera, Genoa). Minerva Med., 53: 1360-2(May 2, 1962). (In Italian)

The dose distribution in the thorax and on the thoracic walls in postoperative therapy of mammary neoplasia with opposed tangential fields was measured for cobalt therapy with a source-skin distance of 44 cm. Results are compared with measurements of dose distribution using 250-kv x radiation with source-skin distance of 50 cm. The experimental data were obtained with plexiglass phantoms filled with water. (tr-auth)

43347 AFTERLOADING APPLICATOR FOR TREATMENT OF CANCER OF THE UTERUS. U. K. Henschke, B. S. Hilaris, G. D. Mahan, and B. S. Proimos (Memorial Hospital for Cancer and Allied Diseases, New York). N. Y. State J. Med., 64: 624-8(1964).

The radiation safety problems which arise in the treatment of uterine carcinoma with radioactive applicators can be greatly reduced by afterloading. An unloaded applicator is inserted into the uterus and vagina in the operating room. After the patient has been returned to her room, the radioactive sources are introduced. In this way, all radiation exposure in the operating room, in the recovery room, and in the diagnostic x ray department is completely avoided, and the radioactive sources are confined to one room, where they can be handled under adequate facilities by experienced personnel. An improved uterus afterloading applicator is described which permits many modifications in treatment technique and isodose pattern according to the individual needs of the patient and the personal preferences of the therapist. (Excerpta Med., Sect. XXIII, 1: (Sept. 1964))

43348 TEMPORAL AND SEQUENTIAL FACTORS IN THE SYNERGISTIC EFFECT OF RADIATION AND CHEMOTHERAPY. D. B. Gillis, Jr., A. P. Trotter, and C. G. Thomas, Jr. (Univ. of North Carolina, Chapel Hill). Proc. Am. Assoc. Cancer Res., 5: 21(1964).

This study was designed to evaluate sequential and temporal factors in achieving a synergistic effect between ionizing radiation and an alkylating agent or a pyrimidine antagonist. Swill-Webster mice weighing approx. 25 g were inoculated intraperitoneally with 1×10^6 Ehrlich ascites tumor cells and subsequently treated with either ^{32}P (chromic radiophosphate) and nitrogen mustard or ^{32}P and 5-fluorouracil. The administration of these agents was varied both as to time (within 4 days) and sequence. Control observations with either ^{32}P or HN_2 alone yielded 65% of survivors free of ascites. 5-FU alone prolonged survival but did not prevent ascites. Concomitant treatment with both ^{32}P and HN_2 proved highly toxic. No other variation in time or sequence of administration of these agents proved any more effective than either alone. Treatment with 5-FU followed by ^{32}P at 1, 24, 48, and 74 hr increased ascites-free survivals to 82.5%. However, immediate treatment with ^{32}P followed by 5-FU at 24 hr yielded a 97.5% incidence of ascites-free survivors. It is concluded that not only can radiosensitivity be enhanced by pre- or concomitant treatment with 5-FU, but cellular repair following radiation injury may be sufficiently impaired by subsequent chemotherapy to cause even greater radiation effect. (Excerpta Med., Sect. XXIII, 1: (Sept. 1964))

43349 THE EFFECT OF IONIZING RADIATIONS AND TUMOUR-CHEMOTHERAPEUTIC AGENTS ON THE BONE MARROW. L. G. Lajtha (Churchill Hospital, Oxford). Progr. Biophys. Biophys. Chem., 11: 79-109(1961).

Tumor chemotherapeutic agents can be divided into alkylating agents and antimetabolites. The alkylating agents include such compounds the HN_2 and HN_3 mustards, Nitromin, Melphalan, R.48, chloroambucil, Degranol, sulfur mustards, myleran, triethylene melamine, triethylene phosphoramide and thio derivatives of triethylene phosphoramide. Their mode of action is not well understood but, because of many similarities with radiation effects, they are described as radiomimetic compounds. The antimetabolites may be subdivided into groups of folic acid antagonists, or analogs, such as aminopterin and α-methopterin; and purine or pyrimidine analogs, such as 6-mercaptopurine, azaguanine, thioguanine, azapyrimidines, halogenated pyrimidines; and miscellaneous compounds, such as urethane, azaserine, or mitomycin C. Any compound that has a growth-inhibiting action shows marked effects on fast-growing cell populations or on tissues where the steady-state equilibrium depends on a fast rate of cell production. Since bone marrow is an organ in which cell populations turn over rapidly, cytotoxic agents show a quick and noticeable effect on it. The direct effects of ionizing radiation and tumor therapeutic agents on the bone marrow are discussed. Emphasis is placed on the use of bone marrow injections in the treatment of radiation injuries and the combination of drugs and radiation in the treatment of leukemia. 88 references. (C.H.)

43350 MEDICAL HIGH-ENERGY RADIATION. Marshall Brucer (Oak Ridge Inst. of Nuclear Studies, Inc., Tenn.). Radiazioni Alta Energia, 1: 5-13(Jan. 1962).

The history of the development of radiation sources is reviewed with emphasis on the development of ^{137}Cs teletherapy machines. It is pointed out that energy levels available and used for radiotherapy have been increased by the development of γ sources, accelerators, and high-energy x-ray machines. (C.H.)

43351 SHORT-DISTANCE GAMMA-RAY THERAPY WITH IRIDIUM-192. J. L. Haybittle (Addenbrooke's Hospital, Cambridge, Eng.). Radiazioni Alta Energia, 1: 32-9(Jan. 1962).

A brief review is given of the history of the use of iridium-192 as a teletherapy source. The most recent iridium-192 unit is described, and reasons are given for thinking that such a unit still is the best and most convenient method of treating superficial lesions at sites adjacent to or involving bone or cartilage. (auth)

43352 CESIUM-137 SOURCES FOR TELETHERAPY (PREPARATION AND SAFETY). J. P. Vigne (Centre Anticancereux, Marseille), R. Amalric and I. P. Cesarini. Radiazioni Aita Energia, 3: 113-18(Apr. 1964). (In French)

The various stages of preparation of sources of ^{137}Cs are described with emphasis on precautionary measures for the manufacture of capsules. (auth)

43353 PELVIC PNEUMOSEPTOGRAPHY. TECHNIQUE AND INDICATIONS. D. de Maria, M. Morini, and L. Vendrame (Universita, Modena, Italy). Radiol. Med., 50: 833-43(Sept. 1964). (In Italian)

An original examination technique is presented: stratigraphy according to the sagittal planes of the vesicovaginal and rectovaginal septa, revealed by means of gas insufflated into the vagina, bladder, and rectum. The chief indication of the pneumoseptographic method is neoplastic pathology of the anterior and posterior vaginal walls. In fact, this method aids the differential diagnosis between neoplastic infiltration and post-irradiation fibrosis. It may sometimes demonstrate the presence of fistulae, permits the study of vaginal relapses of the valut and septa and can serve to estimate the efficacy of radiant treatment through variations of the thickness and morphology of the septa. Finally, it offers useful observations in dosimetry of endocavitary applications of radium. (auth)

43354 PROCEDURES AND CALCULATIONS IN ROTARY AND PENDULUM TELECOBALT THERAPY. D. Palumbo and G. Zaccone (Università, Palermo, Italy). Radiol. Prat., No. 2, 12p.(1956). (In Italian)

The practical and theoretical opportunities in the use of telecobalt therapy with fixed-stand apparatus are reviewed. The rotating chair designed and constructed for the Eldorado A unit at Palermo is described. The solutions of problems of centering are reported. The principle of the dosimetric calculation studied is illustrated. (tr-auth)

43355 EVALUATION OF SYNKAVIT-SENSITIZED RADIATION THERAPY IN RADIORESISTANT ORAL CARCINOMAS. V. Shanta and S. Krishnamurthi (Cancer Inst., Madras). Radiology, 83: 687-9(Oct. 1964).

The effectiveness of Synkavit administered prior to irradiation in carcinoma therapy was studied in 87 cases of carcinoma of the cheek and 40 cases of cancer of the tongue which exhibited a fibrotic reaction and were classed as nonresponsive to radiation. Kilocurie ^{60}Co-beam therapy with standard operating factors and similar dose rates and overall dose was employed in control and Synkavit-treated patients. In cheek carcinoma groups a superior response was statistically suggested in the Synkavit group. However, the differential response in the lingual carcinoma groups did not attain significance. It is concluded that Synkavit sensitization has value in cases exhibiting a moderate degree of fibrotic reaction, where, without the drug, radiation would fail. (H.M.G.)

43356 DOSIMETRIC PROBLEMS ASSOCIATED WITH THE EXAMINATION OF THYROID FUNCTION BY MEANS OF RADIOIODINE. S. Vohnout, S. Roehling, and J. Havelka (Research Inst. of Endocrinology, Prague). Rev. Czech. Med., 10: 17-30(1964).

A critical evaluation of the most commonly used radioiodine tests is divided into 10 groups: measurement of radioiodine uptake in the thyroid gland, measurement of radioiodine excretion in urine, estimation of uptake rates for the thyroid gland, estimation of secretion rates of labelled thyroid hormone, estimation of radiodine in the blood, estimation of radioiodine in saliva, inhibition tests, stimulation tests, gammagraphy of radioiodine deposits in the organism, and autoradiographic methods. Individual groups of tests are evaluated with regard to their use in wider practice, their accuracy, simplicity and unexacting character. The problem of measurement in vivo and in vitro is discussed with regard to the quality and sensitivity of measuring equipment produced in this country. The authors discuss factors which influence the results of measurement: the sensitivity and efficiency of detectors, the reliability of electronic apparatus, the preparation of comparative standards for relative methods, the influence of geometry and the distance of the detector, the position error, the test dose of the isotope and different methods of measurement. On the basis of an analysis of the above conditions the authors recommend the standardisation of the following functional tests: measurement of the ^{131}I uptake curve in the thyroid gland; measurement of the cumulation curve of ^{131}I urinary excretion; measurement of the effective half-life of radioiodine in the thyroid gland; measurement of the conversion ratio of ^{131}I in the blood. (Excerpta Med., Sect. XXIII, 1: (Sept. 1964))

43357 TECHNIQUE AND DOSE DETERMINATION IN RADIUM CONTACT IRRADIATION OF VOCAL CORD CARCINOMA. K. Jatho (Universität, Cologne). Z. Laryngol., Rhinol., Otol., 43: 83-95(1964).

Since Vogel described contact radium irradiation in 1936 this method has been used on strictly selected stage I carcinoma of the vocal cord. The technique of thyroid cartilage fenestration and irradiation has not resulted in complications such as perichondritis or fistula formation in any of the cases and has resulted in 87.5% 3 to 7 year cures. The good results and the absence of complications are due to the special radium cassette with sufficient absorption and distance filtration to avoid damaging the edges of the cartilaginous fenestra. The filtration properties of the radium applicator have been thoroughly tested and tables worked out of the dosage obtained from the cassettes at different levels. The simple method of fenestrating the thyroid cartilage is described. It is stressed that to avoid infection and fistula formation primary wound suture is performed after the insertion of the radium applicator and again after its withdrawal 5 days later. No drainage or marker sutures are used. (Excerpta Med., Sect. XXIII, 1: (Sept. 1964))

CHEMISTRY

General

Refer also to abstract 43151.

43358 (ANL-6800) CHEMICAL ENGINEERING DIVISION SEMIANNUAL REPORT, JULY–DECEMBER 1963. (Argonne National Lab., Ill.). May 1964. Contract W-31-109-eng-38. 429p.

Research and development in chemical engineering is reported under 7 topics. Separate abstracts were prepared for each topic. (J.R.D.)

For abstracts of individual sections see: 43359, 43440, 43706, 44030, 44493, 44723, and 44922.

43359 (ANL-6800(p.43-196)) CHEMICAL-METALLURGICAL PROCESSING. (Argonne National Lab., Ill.).

Development work on the melt refining process for recovery of enriched U is essentially complete, and plant equipment was installed at the EBR-II site. In the EBR-II Fuel Cycle Facility, the melt refining crucible will be covered with a Fiberfrax fume trap to collect the volatilized I activity, as well as other volatile materials such as Na. Laboratory investigations dealing with the behavior of fission-product I_2 in the melt refining process were completed, and the results were evaluated. These investigations involved fuel charges varying from 7 to about 400 g, and irradiation levels ranging from a total atom % burnup of zero to nearly two. In all cases, over 99% of the I_2 present either as a fission product or as a spiked charge was removed when the fuel was melt refined. The deposition pattern of volatilized I activity in the laboratory experiments proved to be dependent primarily upon the temperatures of nearby surfaces during melt refining. In general, the I_2 was found deposited as CsI on surfaces that had been at 400 to 1000°C. These results suggest that in plant operation, most of the I_2 will be collected on the fume trap, although a significant fraction may appear on the upper wall of the melt refining crucible. Experiments were also performed to determine the amount of I activity that will be released to the Argon Cell of the EBR-II Fuel Cycle Facility when the Fiberfrax fume trap is removed from the melt refining surface. Under conditions simulating the fission product decay heat associated with highly irradiated fuel, a slow flow of Ar was passed over a 1-in.-dia. Fiberfrax plug containing deposited I activity. Under the most severe conditions anticipated, it appears that the I activity would be released to the Ar at a rate of less than 0.2%/hr. With appropriate operating procedures, it should be possible to limit the release of I_2 from the Fiberfrax to negligible amounts. Preparations were made for a study of the melt refining of Pu alloys under a molten halide flux. To permit work with large quantities of Pu (50- to 100-g batches), a melt refining furnace which opens into a glove box was reactivated. Preliminary experiments were made with U. The construction of two experimental systems for study of the gettering of N_2 on hot Ti sponge is nearly complete. Shakedown experiments are being made in an apparatus built to determine the kinetics of the N_2/Ti reaction in Ar containing N_2 at initial concentrations between 50 and 50,000 ppM. A 10-cfm pilot plant designed to provide information on component design and reliability for large-volume purification systems is nearly ready for operation. Work was continued on the development of the skull reclamation process, a process in which molten metal (Mg–Zn alloys) and halide salt solvents are employed as processing media for recovery of melt refining crucible residues. These residues, which are called skull material, are converted by controlled oxidation to oxide powders which may be dumped from the melt refining crucibles. Analyses of melt refining crucibles show that the residual or unrecovered U content of these scrap crucibles is between 1 and 3½% of the U in the skull material. Although these losses are somewhat higher than expected, they represent a maximum of only 0.2% of the U in the original melt refining charges, and therefore are not cause for concern. A series of small-scale (100 to 150 g of U) demonstration experiments of the skull reclamation process was completed. The results of these small-scale runs, in which several process difficulties were pinpointed and resolved, showed that adequate fission product removal and U recovery can be achieved in the skull reclamation process. The feasibility of recovering U from other nonsoluble or slightly soluble cladding materials, such as W or a Nb-1% Zr alloy, by a chop-leach procedure was also shown. With the completion of small-scale demonstrations of the skull reclamation process, work was advanced to 2-kg-scale operations in a pilot plant. Particular attention was given in this work to the removal of waste molten metal and salt phases and to the mixing of immiscible metal and salt phases, which are important operations in certain steps of the process. Development work continued on liquid metal separation processes for fast reactor fuels consisting of U–Pu alloys or carbides. Head-end procedures investigated thus far involved either oxidation of the carbide by reagents such as NaOH or $NaNO_3$ in a molten chloride flux, or chlorination of the carbide with HCl or Cl_2 in the same type of flux. Liquid alloys of the ternary system Cd–Zn–Mg are being considered in place of binary Mg–Zn alloys for use as process solvents. U solubility measurements in the Cd-rich region of the ternary alloy indicated maximum values of about 1.5 at. % at 600°C, which should be sufficient for process use. Experimental work relating to the use of a Ca–Zn extraction process for the separation of fission products from Pu and U was completed. The separation in this solvent is based on the high solubility of rare earths and low solubilities of U and Pu in the Ca-rich region. The solubility of U at 750°C was found to decrease sharply from a maximum of 3.0 wt % in Zn–12.5 wt % Ca, to 10^{-3} wt % in Zn–38 wt % Ca, and to continue to decrease to extremely low values at higher Ca concentrations. The decrease in Pu solubility with increasing Ca concentration was much less pronounced. The development of a blanket process for concentrating the Pu bred in EBR-II blanket material was continued. In this process the Pu is separated from the bulk of the U and is present in dilute concentration (about 0.1 wt %) in a 50 wt % Mg–Zn product solution. Evaporation of the Mg and Zn solvent metals to yield a Pu concentrate is being studied. A large-scale Cd distillation unit

(distillation rates of up to 100 kg/hr) has been operated intermittently over the last several years as part of a program to develop engineering technology for the metal distillation or evaporation steps. A de-entrainment device installed in the vapor space of the Cd still pot considerably reduced entrainment of liquid Cd drops in the flowing Cd vapor stream (from several % without the de-entrainment device to as low as 0.9% with the device). In a study of the mechanism of Hg vaporization from the liquid-vapor interface without vapor bubble nucleation within the pool, it was found experimentally that a steep and constant temperature gradient exists in a thin surface liquid layer (about 0.2 in. thick). The largest value of this gradient measured to date is 115°C/in. Below this thin surface layer, the pool temperature was almost constant with depth. The vaporizing liquid surface was superheated an average of 30°C above the vapor space saturation temperature. Work was started to determine the critical constants of alkali metals. Preliminary development work and tests are reported on an eddy-current induction probe for remote determination of molten-metal and molten-salt levels. Materials for the containment of molten U and its alloys and of various molten metals and halide salts are being evaluated. Both W and Ta were shown to be unsuitable for containing molten U systems. Additional information was obtained on a soluble uranyl (V) species, UO_2Cl, that is formed on the addition of UO_3, U_3O_8 or UO_2Cl_2 to molten-chloride solvents. The thermal decomposition of UO_2Cl_2 produces this species via the reaction: $UO_2Cl_2 \rightleftharpoons UO_2Cl + \frac{1}{2} Cl_2$. The equilibrium constant for this reaction at 650°C in the LiCl–KCl eutectic is $1.2 \pm 0.6 \times 10^{-6}$ atm. At temperatures above about 750°C, the thermal decomposition proceeds further, producing solid UO_2 as a product: $UO_2Cl \rightarrow UO_2 + \frac{1}{2} Cl_2$. Additional work was done on pyrometallurgical methods for the preparation of refractory fuel materials. This process involves the addition of C to U dissolved in a Zn–Mg solution, reaction for about 8 hr at 800°C, removal of the supernatant solution, and retorting of the precipitated UC to remove residual Zn and Mg. The product has good pressing and sintering properties. Scouting studies showed that a variety of carbides can be prepared by the reaction of MgC_2 or Mg_2C_3 with halides or oxides of different metals in molten chloride salts. This technique was used successfully for the preparation of Pu_2C_3 from $PuCl_3$. Batches of US with slightly varying S/U ratios were prepared on a 100- to 300-g scale by the reaction of H_2S with hydrided-dehydrided U metal for evaluation. In a demonstration experiment, 30 g of Pu metal was produced by the direct reduction of PuO_2 with Mg–Zn solution in the presence of a $CaCl_2$–$MgCl_2$–MgF_2 flux. The product yield exceeded 99%, and spectrochemical analyses showed the Pu metal to contain lower levels of metallic impurities than did the PuO_2 used as the starting material. Work on the installation, testing, and corrective repair of equipment in the EBR-II Fuel Cycle Facility is described. Heat removal performance tests showed that the cooling system of the Argonne-fabricated interbuilding transfer coffin is adequate to maintain the maximum fuel element temperature in a core subassembly below 600°F. A core subassembly, with electric heaters in the fuel element cans, was used for the tests. A commercially fabricated interbuilding coffin is being modified to conform to the design of the Argonne-fabricated coffin. Two portable sample can cappers have been built and tested. The cappers will press-fit a lid into the type of small can used for transfer of small objects from either of the two EBR-II process cells. Construction of the skull oxidation furnace for the Fuel Cycle Facility has begun. A skull oxide dumper has been tested. This unit dumps the skull from the melt refining crucible into a storage container after the skull has been oxidized in the oxidation step. Experiments are continuing to develop a satisfactory condenser and collector for the collection of metal vapors in the distillation step of the skull reclamation process. The solubility of Pu in liquid Cd is given by the equations: (335 to 399°C) log (at. %) = $6.223 - 4282\ T^{-1}$ and (399 to 632°C) log (at. %) = $5.148 - 5277\ T^{-1} + 1.156 \times 10^6 T^{-2}$. Below 399°C the equilibrium solid phase is $PuCd_{11}$, while between 399 and 632°C it is $PuCd_6$. The Tc-rich phase in the Tc–Zn system was shown to be $TcZn_6$, with a face-centered cubic structure and with $a_0 = 7.588$ Å. The solubility of Ar in liquid Na is 2.4×10^{-7} at. % at 480°C and one atmosphere pressure. The solubility is directly proportional to the pressure, i.e., Henry's law is followed. The heat of solution of Ar in liquid Na is 16 kcal/mole. The analysis of Na for O_2 using an activation method involving the reaction $^{16}O(n,p)^{16}N$ was tested for interference by possible impurities. Studies are under way on the thermodynamics of binary mixtures of the alkali metals using an optical absorption method. A Kovar cell with sapphire windows was found to be resistant to Na vapor to at least 220°C. The decomposition pressure of $TcZn_6$ was measured using the continuous weighing effusion method. The free energy of formation of $TcZn_6$ is given by the equation (470 to 570°C) ΔGf° (cal/g.-atom) = $-7823 + 6.43T$. Extrapolation of these data indicate that $TcZn_6$ will decompose peritectically into Tc metal and solution at 944°C. Thermal analysis data indicate the peritectic temperature is 950°C. The thermodynamics of $PrCd_{11}$ is being studied using a galvanic cell method. Preliminary data indicate that the free energy of formation is –34.2 kcal/mole at 500°C. (auth)

43360 (ORNL-3670(p.112-15)) MATERIALS COMPATIBILITY. J. H. DeVan (Oak Ridge National Lab., Tenn.).

The distribution of oxygen between potassium and alpha-zirconium was investigated at 815°C for times of 100 and 500 hr. Where no oxide scale was visible on the specimens after test, the final weight fraction of oxygen in the zirconium varied from 3 to 30 times that in the potassium. For a specific thickness, the ratio of the weight fractions increased with time, whereas, at a constant time, the ratio decreased with increasing specimen thickness. The rate of oxygen uptake by zirconium is controlled by diffusion of oxygen through the zirconium, so oxygen profiles in the metal could be calculated that were in fair agreement with experiment. Using experimentally determined distribution coefficients for oxygen between zirconium and potassium and a mass balance for oxygen, the total oxygen content of potassium was determined by a gettering–vacuum-fusion technique. This technique gave complete recovery of oxygen from potassium samples doped with K_2O, while amalgamation and vacuum-distillation methods yielded low values. Essentially complete recoveries of oxygen from doped potassium samples were found, using a fast-neutron activation technique that employed the reaction $^{16}O(n,p)^{16}N$. However, the analytic precision of this method was poor. (auth)

43361 (ORNL-P-238) THEORY OF FISSION-PRODUCT FRACTIONATION IN REACTOR FUEL EX-

PERIMENTS, REACTOR ACCIDENTS, AND WEAPONS FALLOUT. C. E. Miller, Jr., W. E. Browning, Jr., B. F. Roberts, and R. P. Shields (Oak Ridge National Lab., Tenn.). [July 31, 1964]. Contract W-7405-eng-26. 10p. (CONF-571-12)

From American Chemical Society 148th National Meeting, Chicago, Aug.-Sept. 1964.

The fractionation of fission products released in the melting of stainless steel-clad UO_2 fuel elements is discussed. A model for predicting fission product fractionation was developed on the basis of vaporization equilibrium and dilution in the vapor. The model is in good agreement with data on the melting of clad UO_2; the results indicate that fission products vaporize in the elemental form and that the mechanism of fractionation is a simple vapor transpiration process. The application of the model to other release experiments and to fallout from atomic explosions (using condensation as the fractionation step) is described. (D.L.C.)

43362 (ORNL-P-321) A LABORATORY EVALUATION OF THE CHEMICAL AND PHYSICAL PHENOMENA ASSOCIATED WITH CYCLIC SORPTION-DESORPTION OF URANIUM HEXAFLUORIDE ON SODIUM FLUORIDE. Sidney Katz (Oak Ridge National Lab., Tenn.). [nd]. Contract W-7405-eng-26. 17p. (CONF-653-4)

From American Chemical Society Symposium, Chicago, Sept. 1964.

Problems in the use of NaF pellets to sorb and separate UF_6 from other gases are: the failure to sorb stoichiometrically to $UF_6 \cdot 2$ NaF, deterioration of NaF pellets on successive sorption-desorption cycles, and lack of information on the sorption of other gases. Static gasometric studies were made of these problems. Activated (high surface area) NaF was found to sorb UF_6 stoichiometrically at 150°C, while pellets sorb only $\frac{1}{3}$ of the stoichiometric capacity, suggesting that pellets do not have sufficient volume to form the stoichiometric complex. Factors important for high sorption capacity and in pellet deterioration were studied and are listed. Dissociation pressures were determined for the complexes of NaF with UF_6, MoF_6, and WF_6. (D.L.C.)

43363 (SC-T-64-1608) IONIC ETCHING AS A MATERIAL EXAMINATION METHOD IN ELECTRON DIFFRACTOGRAPHS. M. Gribi and L. Wegmann. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Dechema Monograph., 36: 47-63(1959). 19p.

The use of electron beams as a probe in the study of the surface of a solid is discussed. The removal of layers of the surface by chemical etching during electron diffraction studies has many disadvantages. Etching with an ion beam avoids these limitations, and successive 1-Angstrom-thick layers can be removed in vacuum without chemical or crystallographic changes. The conditions for ionic etching and the mechanical reorientation effect are discussed. An ionic etching device and its operation with an electron diffractograph is described. (D.L.C.)

43364 ADVANCES IN INORGANIC CHEMISTRY AND RADIOCHEMISTRY. H. J. Emeléus and A. G. Sharpe, eds. Advan. Inorg. Chem. Radiochem., 6: 1-530(1964). New York, Academic Press, 1964. $16.00.

Topics covered in this review are: complexes of transition metals with phosphines, arsines, and stilbines; anhydrous metal nitrates; chemical reactions in electric discharges; chemistry of astatine; chemistry of silicon-nitrogen compounds; peroxy compounds of transition metals; direct synthesis of organosilicon compounds; and the Mössbauer effect and its application in chemistry. Separate abstracts were prepared for 3 of the 8 papers. (M.C.G.)

For abstracts of individual papers see: 43457, 43458, and 43602.

43365 REPORT OF THE NATIONAL CHEMICAL LABORATORY 1963. Report of the Steering Committee and Report of the Director of the National Chemical Laboratory for 1963. (Gt. Brit. Dept. of Scientific and Industrial Research). 1964. 82p. 5s. 6d. (HMSO)

Research carried out during 1963 by the chemical thermodynamics, new materials, inorganic and mineral chemistry, corrosion of metals groups and the isotope application unit is reported. (P.C.H.)

Analytical Procedures

43366 (AERE-R-4644) THE DETERMINATION OF NITROGEN IN URANIUM NITRIDES. PART I. G. W. C. Milner, D. H. Rowe, E. Foster, and G. Phillips (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). Aug. 1964. 18p.

The Dumas method has been applied to the determination of the nitrogen contents of uranium nitrides. For uncontaminated samples, an inactive apparatus was used for the analysis and the coefficient of variation for a determination was about 0.5%. However, for the analysis of samples slightly contaminated with alpha emitters, the apparatus and technique was modified for operation in a glove box. Handling difficulties associated with glove box work resulted in a poorer precision for this determination, a coefficient of variation of less than 1% being obtained under these conditions. Results are given for the complete analysis of the nitride samples examined in this study, and full details of the active apparatus and technique are reported. (auth)

43367 (ANL-6913) APPLICATION OF THE VACUUM-CUP TECHNIQUE TOWARD SPECTROCHEMICAL ANALYSIS OF URANIUM–FISSIUM ALLOY. Yu Yokoyama and John P. Faris (Argonne National Lab., Ill.). July 1964. Contract W-31-109-eng-38. 13p.

The vacuum-cup technique of spectrographic analysis has been studied in some detail for possible use in the analysis of uranium or uranium–plutonium alloys containing some fission product elements. The changes in spectral line intensities of molybdenum, ruthenium, rhodium, and palladium were investigated in relation to several factors such as discharge type, discharge current, form of electrode, consumption of sample solution, and consumption of electrodes. Spectral intensities correlated with consumption of sample solution but were influenced to a large extent by the deposition of solutes on the electrode surface and to some degree by concentration of the sample solution by heat. Satisfactory working curves could be obtained by adding nickel to serve as an internal standard. For this particular application, however, the method offered no outstanding advantages over other solution techniques of spectrochemical analysis. (auth)

43368 (ASD-TDR-62-1038(Pt.III)(Vol.I)) ACTIVATION ANALYSIS FOR IMPURITIES IN BERYLLIUM. Period Covered: January 1, 1963–January 31, 1964. I. L. Morgan, J. B. Ashe, J. T. Prud'homme, and T. C.

Martin (Texas Nuclear Corp., Austin, Tex.). Jan. 1964. Contract AF33(616)-8160. 80p. (AD-601324)

A list of cross section data and related information was compiled for total neutron cross sections and the reaction cross sections, (n,p), (n,alpha), and (n,2n) in the energy region around 14 Mev. This compilation includes published data through June, 1963. A gamma ray spectral atlas containing 54 sets of spectra of some of the more common elements in the periodic table was obtained by activation analysis with 14.8 Mev neutrons. Gamma ray peaks from the reaction products were identified as well as radioactive decay products from trace impurities in each element whenever possible. Carbon and nitrogen surface contamination of several high purity beryllium samples were measured by proton irradiation. The results seem to indicate that a large percentage of this contamination is in surface layers suggesting that these contaminants may have been added during a machining process. (auth)

43369 (CONF-721-1) ADAPTATION OF THE CHROMATOGRAPH FOR THE ANALYSIS OF CORROSIVE GASES. R. L. Harris, T. J. Mayo, W. R. Rossmassler, and E. L. Williamson (Oak Ridge National Lab., Tenn.). [nd]. Contract W-7405-eng-26. 21p.

From 8th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn., Oct. 1964.

Two chromatographs were developed for the determination of such corrosive gases as F_2, HF, UF_6, etc. Nickel or Monel tubing is used, and fluorine-containing polymers are utilized in the column. The sampling system, consisting of five air-operated valves, is described. The effects of carrier gas (air and fluorocarbon-12) on the sensitivity were studied. Some typical chromatograms of mixtures of corrosive gases are given, and results are tabulated for HF and F_2 analyses. (D.L.C.)

43370 (DPSPU-64-30-20) DETERMINATION OF PROMETHIUM-147 IN ENVIRONMENTAL SAMPLES. R. W. Taylor (Du Pont de Nemours (E. I.) & Co. Savannah River Plant, Aiken, S. C.). Sept. 1964. Contract AT(07-2)-1. 10p. (CONF-727-3)

From 10th Annual Bioassay and Analytical Chemistry Meeting, Cincinnati, Oct. 1964.

A procedure employing a combination of simple analytical techniques was developed to determine Pm^{147} in environmental samples. Lanthanides were initially precipitated from solution as hydroxides. Rare earths that interfere with beta counting of ^{147}Pm and other contaminants were removed by ion exchange, solvent extraction, and precipitation. ^{147}Pm was finally co-precipitated with neodymium oxalate, fired to the oxide, and counted in a gas-flow proportional counter. Recovery was 71% ± 9% (relative standard deviation). Decontamination factors for fission products usually found in environmental samples were >10,000. (auth)

43371 (GA-5073) UTILIZATION OF REACTOR FAST NEUTRONS FOR ACTIVATION ANALYSIS. Annual Report for the Period Ending November 30, 1963. H. P. Yule, H. R. Lukens, Jr., and V. P. Guinn (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Mar. 25, 1964. Contract AT(04-3)-167. 104p.

Utilization for neutron activation analysis of the relatively high fluxes of fast neutrons that exist in and around the core of a nuclear reactor is bein systematically investigated. The yields of gamma-emitting isotopes from the naturally occurring isotopes of all the stable elements due to the (n,p), (n,α), (n,2n), and (n,γ) reactions under defined conditions were computed and tabulated, and the determinable yields of fast neutron activation products from 35 elements studied experimentally are given. A number of instances wherein fast neutron reactions provide a useful or superior analytical route are shown. The work also provides a measure of analytical interferences due to competing reactions. Results of shielding studies for suppression of (n,γ) reactions are given. Complete experimental details are given and the various techniques employed, such as spectrum stripping, reactor pulsing, and data reduction by computer, are discussed. (auth)

43372 (HW-SA-3680) ANTICOINCIDENCE SHIELDED, MULTIDIMENSIONAL GAMMA-RAY SPECTROMETRY FOR DIRECT HIGH-SENSITIVITY ANALYSIS OF RADIONUCLIDE MIXTURES. R. W. Perkins (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 4, 1964. Contract AT(45-1)-1350. 30p. (CONF-749-1)

From International Conference on Analytical Chemistry, Vienna, Oct. 1964.

A detector system is described which gives ultra-low background and minimum Compton response and which uses coincidence techniques to identify radionuclides. The sample is viewed by two detectors contained within a third detector as an anticoincidence annulus. A multiparameter analyzer is used for storing the normal and coincidence spectra. The applications of the detector system in the analysis of complex radionuclide mixtures include: airborne radionuclides, reactor effluent water, ^{22}Na in food and people, bioassays, and ^{24}Na, ^{38}S, and ^{38}Cl from cosmic rays. (D.L.C.)

43373 (KAPL-M-6166) TWEX — A TWO-EXPONENTIAL DATA REDUCTION PROGRAM FOR THE IBM-1620. R. A. Reiter (Knolls Atomic Power Lab., Schenectady, N. Y.). July 22, 1964. Contract W-31-109-eng-52. 10p.

The TWEX (Two Exponential) program for the IBM 1620 computer was written to analyze radioactive decay data from samples exhibiting two distinct half lives. A least squares method is used to determine the amplitudes of the two decay modes and errors are estimated from counting statistics and the dispersion of the points. The input and output of the program are described. (auth)

43374 (LA-3132-MS(p.245-8)) GRADPRO: AN EQUILIBRIUM DENSITY GRADIENT ULTRACENTRIFUGAL COMPUTER PROGRAM. G. R. Shepherd, P. N. Dean, and B. J. Noland (Los Alamos Scientific Lab., N. Mex.).

The technique of equilibrium density gradient ultracentrifugation is used in the analysis of biological material. Data obtained by this technique yield information on the density, heterogeneity, molecular weight, and base content of DNA samples. Calculations involved in evaluation of the experimental data are lengthy and susceptible to error. Therefore, a computer program was designed and written in FORTRAN II for the IBM 704/7090 (Monitor System) to carry out these calculations. The program was designed to accept data in the form in which it was obtained experimentally and to calculate mean DNA-band center distance from the center of rotation (r_0 cm); density of liquid column (g/cc) at point r_0; density gradient (g/cc/cm) at point r_0; and molecular weight of DNA (based upon variance of band tracing). The program was tested experimentally. (C.H.)

43375 (LA-3132-MS(p.249-51)) SPECTROPHOTOMETRIC ANALYSIS OF NUCLEIC ACID DERIVATIVES. G. T. Fritz (Los Alamos Scientific Lab., N. Mex.).

To provide a means of identifying and characterizing oligonucleotides, a library of infrared and ultraviolet spectra of nucleic acid derivatives is being built. A computer program was adapted for analyzing multicomponent ultraviolet spectra. The initial object of the study was the determination of the amounts of individual purine and pyrimidine bases in nucleic acid hydrolysates. The study was extended to include spectra of nucleosides and nucleotides to provide a method of analysis for the base ratios of oligonucleotides methods and results are discussed. (C.H.)

43376 (LA-3135) X-RAY ABSORPTION EDGE DETERMINATION OF RHENIUM IN RHENIUM–URANIUM–ZIRCONIUM CARBIDE. E. A. Hakkila, R. G. Hurley, and G. R. Waterbury (Los Alamos Scientific Lab., N. Mex.). Aug. 15, 1964. Contract W-7405-eng-36. 14p.

Rhenium is determined in rhenium–uranium–zirconium carbide using an x-ray absorption edge method. In this method a bismuth–thallium alloy is irradiated with x rays from a tungsten-target x-ray tube, and the secondary x rays of bismuth and thallium are transmitted through an absorption cell filled successively with water, suitable known solutions, and the sample solution. The L III absorption edge for rhenium at 1.177 A occurs between the $L\alpha_1$ lines for thallium at 1.207 A and for bismuth at 1.144 A. Measured transmitted intensities are related to rhenium concentration using accepted absorption principles. The method is applicable to the determination of rhenium concentrations of 20 to 100 percent with relative standard deviations in the range of 2.8 to 0.6 percent, respectively. Only gallium, ytterbium, lutetium, and hafnium have absorption edges between the x-ray lines used for this analysis and interfere in this method. (auth)

43377 (NBL-215) THE EMISSION SPECTROCHEMICAL DETERMINATION OF IMPURITIES IN PLUTONIUM. A. W. Wenzel and C. E. Pietri (New Brunswick Lab., AEC, N. J.). Sept. 1964. 49p.

Quantitative emission spectrographic methods have been developed for the determination of impurities in plutonium using a spectrograph modified for gloved box operations. In one procedure, plutonium is separated from its impurities by adsorption on Dowex-1 anion-exchange resin in 8N HNO_3 to minimize spectral interference and health hazards. The impurity-rich effluent is analyzed under conditions developed for maximum sensitivity by excitation in a direct current arc using a gallium oxide matrix. Twenty-two elements (Ag, Al, Am, Ba, Be, Ca, Cd, Cr, Cs, Cu, Fe, K, Li, Mg, Mn, Mo, Na, Ni, Pb, Rb, V, and Zn) can be determined by this method. The average relative standard deviation of the method for densitometered elements is 15%. The lower limits of detection of the impurities compare favorably with those obtained by the carrier-distillation method and the cupferron-extraction method. The method has been used to analyze plutonium metal, plutonium sulfates, and plutonium nitrate solutions; it has been adapted to the analysis of dicesium plutonium hexachloride salts using a cesium chloride matrix; and it has been applied to plutonium-uranium compounds using a hydrochloric acid adsorption-elution scheme. The second procedure employs a cation-exchange resin, Dowex-50, for adsorption of plutonium in 0.2N HNO_3, allowing the impurities to pass into the effluent. The method is used to determine boron and silicon which cannot be adequately determined using the anion-exchange separation technique. Direct current arc techniques are used; boiler-cap electrodes and a sodium carbonate buffer afford optimum conditions for silicon determination while mannitol-complexing and an indium oxide matrix aid in the determination of boron. The average relative standard deviation for silicon is less than 9% while that for boron is within 12%. (auth)

43378 (NLCO-920) SUMMARY TECHNICAL REPORT [ON FEED MATERIALS], APRIL 1, 1964–JUNE 30, 1964. R. Burgett, ed. (National Lead Co. of Ohio, Cincinnati). Aug. 19, 1964. Contract AT(30-1)-1156. 62p.

Abstracts are prepared for the nine sections of the report. (N.W.R.)

For abstracts of individual papers see: 43379, 43380, 43381, 43382, 43383, 43712, 43889, 44098, and 44099.

43379 (NLCO-920(p.7-12)) CATHODOLUMINESCENCE AS AN ANCILLARY TECHNIQUE TO MICROPROBE ANALYSIS. J. W. Colby and W. N. Wise (National Lead Co. of Ohio, Cincinnati).

Cathodoluminescence may be employed in conjunction with standard microprobe analytical techniques to locate and identify phases containing light elements. Its use is illustrated in the analysis of a mixture of MgF_2, CaF_2, MgO, and uranium. (auth)

43380 (NLCO-920(p.13-17)) MICROPROBE ANALYSIS OF URANIUM METAL RECOVERED FROM MAGNESIUM FLUORIDE SLAG. J. W. Colby and W. N. Wise (National Lead Co. of Ohio, Cincinnati).

A sample of uranium metal recovered from magnesium fluoride slag was analyzed in the microprobe and the various phases were identified. A modification of the microprobe to enable more precise measurements of sample current is described. (auth)

43381 (NLCO-920(p.25-9)) PETROGRAPHIC EXAMINATION OF COIL-ENCAPSULATING CERAMICS. W. W. Brock (National Lead Co. of Ohio, Cincinnati).

Petrographic examinations showed specific chemical and physical differences between the mullite refractory, used in the conventional induction furnaces, and the alumina refractory used to encapsulate the improved induction coil assembly. (auth)

43382 (NLCO-920(p.31-6)) CLASSIFICATION OF DERBY GRADES BY DENSITY MEASUREMENTS. A. R. Diehl (National Lead Co. of Ohio, Cincinnati).

An effective method of ascertaining the degree of slag separation in uranium reguli (derbies) was developed and tested. According to Archimedes' principle of bulk density, the derbies are weighed both wet and dry before and after shot-blasting and their densities are calculated. Measurements were made in both non-plant and actual plant environments. (auth)

43383 (NLCO-920(p.57-61)) DETERMINATION OF THE THORIUM-230, THORIUM-232 RATIO IN THORIUM MATERIALS. B. L. Twitty (National Lead Co. of Ohio, Cincinnati).

A method of alpha spectrometry is developed to determine the ^{230}Th, ^{232}Th ratio in various thorium materials. The thorium is extracted into α-thenoyltrifluoroacetone (TTA) from a nitrate medium at controlled pH and evaporated onto a stainless steel planchet. The thorium spectra are obtained with a Frisch grid chamber. After a 2-hour count, the precision is ±15.6% at the 0.3 ppm level. After

a 16-hour count, the precision is ±7.2% at the same level. Both precision values are at the 95% confidence level. (auth)

43384 (NLCO-921) MICROPROBE ANALYSIS OF BINARY SYSTEMS CONTAINING URANIUM. J. W. Colby (National Lead Co. of Ohio, Cincinnati). Aug. 3, 1964. Contract AT(30-1)-1156. 32p. (CONF-715-1)

From 13th Annual Conference on Applications of X-Ray Analysis, Denver, Aug. 1964.

Several binary systems of uranium with lighter elements (atomic numbers of 6 to 26) have been analyzed in an ARL microprobe analyzer using conventional x-ray techniques and also by sample-current measurements. The techniques of the analysis, the parameters employed, and the results obtained are discussed. (auth)

43385 (ORNL-P-447) DETERMINATION OF NUCLIDE CONCENTRATIONS IN SOLUTIONS CONTAINING LOW LEVELS OF RADIOACTIVITY BY LEAST-SQUARES RESOLUTION OF THE GAMMA-RAY SPECTRA. E. Schonfeld, A. H. Kibbey, and W. Davis, Jr. (Oak Ridge National Lab., Tenn.). [Sept. 3, 1964]. Contract [W-7405-eng-26]. 42p. (CONF-721-2)

From 8th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn., Oct. 1964.

Gamma-ray spectrum resolution, a rapid, cheap method for determining the radionuclide content of solutions, was tested for use in studies of processes concerned with the decontamination of waste water containing only 10^2 to 10^5 $\mu\mu$C of radionuclides per liter. Tests, with two multichannel spectrometers, and associated data analyses by the method of least squares, were made with solutions of ^{60}Co, ^{85}Sr, ^{141}Ce, and ^{144}Ce added as tracers to water containing ^{90}Sr, ^{95}Zr–Nb, ^{106}Ru, ^{134}Cs, and ^{137}Cs. The lowest concentration of radioactivity was about one-tenth of the lowest value previously determined by this technique. Some of the solutions were concentrated by evaporation by factors up to 20 to evaluate this feature for improving accuracies of analyses. For comparison, the solutions were also analyzed by standard radiochemical methods. Agreement between the two methods was excellent for ^{60}Co and ^{85}Sr for concentrations down to about 500 $\mu\mu$C/liter (scatter of ±5 to ±20%). Agreement between the two methods was good for ^{137}Cs at activities down to 3000 to 4000 $\mu\mu$C/liter; comparative values from the two methods differed by factors of 5 to 10 for ^{144}Ce except at activities above 5000 $\mu\mu$C/liter. More dilute solutions were successfully analyzed only if they were first concentrated by evaporation. Because of large statistical fluctuations at ^{106}Ru concentrations as high as 1000 to 2000 $\mu\mu$C/liter, no particular significance can be given to the data for this nuclide. Several contributions to the mathematical techniques of gamma-ray spectrum resolution are reported. These include: data showing that gain shifts up to 5%, and threshold shifts of two channels, can be accurately handled by a computer program; resolution of the errors of concentration estimates into contributions by background and the various radioactive species present; and use of chi-square to test the overall reliability of the multichannel spectrometer. (auth)

43386 (ORNL-P-473) EXPERIMENTAL STUDY OF ARTIFACTS AND ERRORS ENCOUNTERED IN GAMMA-RAY SPECTROMETRY FOR RADIOCHEMISTRY AND ACTIVATION ANALYSIS. W. S. Lyon, J. S. Eldridge, and P. Crowther (Oak Ridge National Lab., Tenn.). [1963]. Contract [W-7405-eng-26]. 31p. (CONF-731-2)

From IAEA Symposium on Radiochemical Methods of Analysis, Salzburg, Austria, Oct. 1964.

Several phenomena that introduce possible errors in NaI gamma-ray spectrometry are described. Gamma spectra from ^{64}Cu are given for several source-detector geometries. (R.E.U.)

43387 (ORNL-P-479) THE USE OF ISOTOPIC NEUTRON SOURCES FOR CHEMICAL ANALYSIS. J. E. Strain and W. S. Lyon (Oak Ridge National Lab., Tenn.). [1964]. Contract [W-7405-eng-26]. 26p. (CONF-731-1)

From IAEA Symposium on Radiochemical Methods of Analysis, Salzburg, Austria, Oct. 1964.

The alpha-initiated, photon-initiated, and spontaneous-fission types of isotopic neutron sources are described. Alpha-initiated ^{241}Am–Be neutron sources are most useful, and examples are given of their applications to neutron absorption, transmission, and activation analysis. (D.L.C.)

43388 (RFP-420) THE SPECTROGRAPHIC DETERMINATION OF CESIUM IN PLUTONIUM METAL. E. Vejvoda (Dow Chemical Co. Rocky Flats Div., Golden, Colo.). Sept. 16, 1964. Contract AT(29-1)-1106. 9p.

A spectrographic-photometric procedure was developed for determining the Cs contamination in Pu metal produced by the electrorefining process using Cs_2PuCl_6. The metal sample is dissolved in HCl and a part of the solution is placed onto NaF in a shallow electrode crater. The Cs impurity spectrum is recorded on a photographic plate and the concentration determined photometrically. Rb is used as an internal standard. Relative standard deviations and accuracy were evaluated. (D.L.C.)

43389 (RFP-424) RAPID DETERMINATION OF ALUMINUM IN PLUTONIUM PEROXIDE CAKE. H. N. Barton (Dow Chemical Co. Rocky Flats Div., Golden, Colo.). Oct. 2, 1964. Contract AT(29-1)-1106. 9p.

A carrier distillation spectrochemical method had been successfully adapted to direct reading spectrometry. Direct reading techniques have been developed for the rapid analyses of aluminum in plutonium peroxide to demonstrate the capability of direct reading for process impurity control. (auth)

43390 (TID-20643) USE OF RADIOISOTOPES AS A SOURCE OF X-RAYS TO DEVELOP A RAYLEIGH SCATTERING METHOD FOR THE ANALYSIS OF HIGH Z ATOMS IN A LOW Z MEDIA. Final Report. Joris M. Brinkerhoff (Tracerlab. Div. of Lab for Electronics, Inc., Waltham, Mass.). July 1963. Contract AT(30-1)-2533. 29p.

The possibilities of Rayleigh scattering of (radioisotope-produced) x radiation for chemical analysis of heavy atoms in low atomic number media are studied. The application selected was the determination of the uranium content of aluminum–uranium alloy reactor fuel plates, utilizing the principle of the enhanced Rayleigh scattering of x radiation by high atomic number materials. The radioisotope chosen for this application was krypton-85, whose beta radiation was employed to excite the x-ray fluorescence of uranium. This x-ray fluorescence in turn was then allowed to undergo Rayleigh scattering by the uranium in the fuel plates. Preliminary tests were made which demonstrated the technical soundness of the principle and established various operating characteristics to be expected from a prototype instrument. The design, fabrication, and evaluation of the prototype instrument consisting of radiation detectors, collimators, source, and associated hardware are outlined. While it was apparent that the instrument could indeed indicate the uranium concentration

to a precision of around 0.1%, the actual accuracy was limited to 1.0% due to critical variables such as positioning and geometry of the samples. The instrument was considered to be useful in connection with the problem of where to cut off the ends of ingots containing hot spots and as a means for nondestructive examination. (N.W.R.)

43391 ISOTOPE FRACTIONATION IN THE ADSORPTION CHROMATOGRAPHY OF DOUBLY-LABELED COMPOUNDS. Peter D. Klein (Argonne National Lab., Ill.). Atomlight, No. 41, 1-7(Oct. 1964).

The double label technique for the comparison of two compounds is discussed. The validity of the double label technique in the chromatographic identification of sterol acetates was tested. A mixture of 150000 cpm cholesterol acetate-2-^{3}H and 300000 cpm cholesterol acetate-1-^{14}C was used. More than 97% of each isotope was recovered in the chromatogram. The elution pattern of the ^{3}H-labeled acetate was noticeably displaced with respect to the ^{14}C-acetate. In order to use the isotope ratio technique to compare two different compounds, certain baseline comparisons of a single compound, double labeled, are necessary. These are the behavior of the ratio when both isotopes are in the acetate group, when the sterols are doubly labeled, and when one sterol acetate is labeled in the sterol portion, and the other sterol acetate is labeled in the acetate portion. Isotope effects in the chromatography of double labeled compounds are also discussed. (P.C.H.)

43392 THE ELECTROMETRIC TITRATION OF THORIUM WITH TELLURITE. V. K. Sharma and J. N. Gaur (Univ. of Rajasthan, Jaipur, India). Bull. Chem. Soc. Japan, 37: 1091-2(Aug. 1964).

Potentiometric and conductometric titrations of thorium nitrate solutions with tellurite show a sharp break at the 1:2 (Th:Te) ratio. Direct volumetric titrations using phenolphthalein as an indicator also show the 1:2 ratio, indicating the formation of normal tellurite. The estimation of thorium by potentiometric, conductometric, and direct volumetric titrations using potassium tellurite is suggested. (auth)

43393 THE SOLVENT EXTRACTION AND SPECTROPHOTOMETRIC DETERMINATION OF URANIUM USING BENZOYLTRIFLUOROACETONE AS THE CHELATING REAGENT. Tsunenobu Shigematsu, Masayuki Tabushi, and Masakazu Matsui (Tokyo Univ.). Bull. Chem. Soc. Japan, 37: 1333-46(Sept. 1964).

The solvent extraction of uranium as a benzoyltrifluoroacetone (BTFA) chelate was investigated, and a procedure for the separation and spectrophotometric determination of the element is proposed. The results showed that the uranium BTFA chelate can be extracted at the lowest pH value and from the widest pH range among the chelates of three other β-diketones (trifluoroacetylacetone, acetylacetone, and dibenzoylmethane). It was concluded that the BTFA method is most suitable for the extraction of uranium, although it is less sensitive than the dibenzoylmethane method with regard to the spectrophotometric method. (P.C.H.)

43394 PHOTOMETRIC DETERMINATION OF THE RARE EARTHS WITH XYLENOL ORANGE. Kailash N. Munshi and Arun K. Dey (Univ. of Allahabad, India). Chemist-Analyst, 53: 105-6(Oct. 1964).

Optimum conditions for the spectrophotometric determination of each of the rare earths with xylenol orange as the chromogenic agent are reported. (P.C.H.)

43395 THE USE OF TRI-CAPRYLYL-MONOMETHYL AMMONIUM CHLORIDE IN REVERSED-PHASE CHROMATOGRAPHY OF URANIUM, ZIRCONIUM, HAFNIUM AND TRANSITION METALS OF THE IRON GROUP. E. Cerrai and G. Ghersini (Laboratori CISE, Milan). Energia Nucl. (Milan), 11: 441-43(Aug. 1964).

Results obtained using paper treated with tri-caprylylmonomethyl ammonium chloride and eluted with HCl of various molarities are described. Experiments were performed on U, Zr, Hf, Fe, Co, and Ni. Parallel experiments were carried out with paper treated with tri-n-octylamine (TOA). A comparison of experimental results showed that papers treated with ammonium salt or TOA of the same concentration present similar behavior. In addition, the general aspects of results agree with those expected from liquid-liquid extraction data. (P.C.H.)

43396 MASS SPECTROSCOPIC DETERMINATION OF LITHIUM CONTENT OF SOME EGYPTIAN ROCKS AND WATER SOURCES BY THE METHOD OF STABLE ISOTOPE DILUTION. Sayed B. El-Kholy and Farouk H. Makary (Atomic Energy Establishment, Cairo). Geofis. Pure Appl., 57: 125-32(1964).

The isotopic dilution technique was used to determine the lithium content in three water samples and one solid sample extracted from four different localities in U.A.R. The results are tabulated. (P.C.H.)

43397 RADIOCHEMICAL DETERMINATION OF URANIUM OF LOW ACTIVITY. L. A. Currie, G. M. France, III, and P. A. Mullen (National Bureau of Standards, Washington, D. C.). Health Phys., 10: 751-5(Oct. 1964).

A systematic investigation of uranium analysis was undertaken down to levels as low as one-tenth of the respective maximum permissible concentrations in water and in urine. Two procedures were developed, having improved recoveries and reproducibilities of 0.96 ± 0.04 and 0.87 ± 0.06, based upon six and seven samples, respectively. (The indicated values are the arithmetic mean and computed standard deviation of a single determination.) The procedures require only 25-ml samples and considerably less than one generally accepted procedure. The recovery of one of the procedures showed no significant change when uranium concentration varied by about a factor of 10^{6}. (auth)

43398 ACTIVATION ANALYSIS. V. P. Guinn (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Ind. Res., 6: No. 9, 30-6(Oct. 1964).

Developments and applications of activation analysis are reviewed. The advantages of activation analysis over other methods of analysis are discussed. (P.C.H.)

43399 ACTIVATION ANALYSIS FOR COPPER AND MANGANESE IN BIOLOGICAL OBJECTS. A. A. Kist, L. S. Zvyagina, E. M. Lobanov, A. I. Sviridova, G. Moskovtseva, and V. I. Zvyagin (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk, No. 2, 77-80(1964). (In Russian)

The manganese and copper contents in biological objects were determined by activation. The analytical results calculated using the induced β and γ activities indicated for Cu: $(9.2 \pm 1.52) \times 10^{-4}$% in the brain and 1.4×10^{-3}% in the liver; for Mn: $(2.16 \pm 0.39) \times 10^{-4}$% in the brain and 5.9×10^{-4}% in the liver. (R.V.J.)

43400 SEPARATION OF ISOMERIC DIIODOBENZENE AND IODOBENZENE BY PAPER CHROMATOGRAPHY AND THEIR DETECTION BY ACTIVATION ANALYSES. F. Baumgaertner and A. Schoen (Technische Hochschule, Munich). J. Chromatog., 13: 266-8(1964). (EUR 1860.d). (In German)

When uranium fission occurs in the presence of iodobenzene the fission iodine is partly bound in the form of iodobenzene. In order to find out whether diiodobenzene is being formed at the same time with iodobenzene the iodobenzene and the isomeric diiodobenzenes had to be separated. A simple separation by paper chromatography was worked out using paper as the solvent (descending). The detection of the micro-amounts of the compounds separated could not be achieved by known chemical analytical methods; therefore, neutron activation analyses were used. The paper chromatograms were irradiated in a thermal neutron flux of $5 \cdot 10^{12}$ n/cm^2 sec. The irradiated paper strip was then attached to the recorder of a single-channel-pulse-height-analyzer (Telefunken Co.) and then moved in front of a lead collimator with the speed of the recorder chart. Behind the lead collimator a scintillation detector was mounted and attached to the single-channel-pulse-height-analyzer. This one was set at the γ energy of the 0.45 Mev iodine-128 line. This is necessary in order to detect the low iodine activity among the chlorine and sodium activities of the paper. The counting rate recorder of the single-channel-pulse-height analyzer was directly coupled with the recorder paper chart that moves the paper chromatogram. Therefore a linear connection was given between the distribution of the iodine compounds on the paper chromatogram and the corresponding peaks on the recorder chart. The location of the iodine compounds on the paper chromatogram was easily found by transferring the distances of the peaks on the recorder chart to the paper chromatogram. The Rf-values found are given. (auth)

43401 REACTOR ACTIVATION OF CERTAIN SANDS AND CLAYS. Richard L. Lehman and Juerg Zeller (Univ. of California, Berkeley). J. Geophys. Res., 69: 4247-55 (Oct. 15, 1964). (UCRL-11304)

The total γ-ray intensity and the amounts of the principal radioisotopes have been measured between 2 and 100 hours after the end of a short activation of some natural sands and clays. The dominant radioactivity of alluvial sands of the Linth-Limmat river system (Switzerland) between 2 and 20 hours is from ^{56}Mn and between 20 and 99+ hours it is from ^{24}Na. The atomic densities of Na and Mn in these sands, as determined by neutron activation, average 4.2×10^{20} and 0.043×10^{20} cm^{-3}, respectively. The residual radioactivity 40 days after the end of a 15-min activation is about 0.001 that at 30 hours. Certain of the mineral grains in the sands were studied separately. The atomic densities of Na and Mn are reported for dolomite, quartz, sernifite, and serpentine grains, and of sodium alone for sodium bentonite and opalinus clays. There is a variation by a factor of 40 or more in the induced ^{24}Na radioactivity of equal-sized grains of the same mineral fraction. The induced radioactivity decreases by a factor of 0.5 when the grain size is increased from 0 to 6 mm and by a factor of 0.8 when the sample size is increased from 0 to 6 grams. Activation factors for a 15-min activation of certain chemical elements at pile factor 30 are given. These factors are used in computing the expected radioactivity induced by such an activation in igneous rock, sedimentary rock, and limestone. (auth)

43402 RADIOCHEMICAL DETERMINATION OF PLUTONIUM ISOTOPES AND AMERICIUM-241 IN A PLUTONIUM SAMPLE. Kenju Watanabe, Eiji Sakai, and Kentaro Minami (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 1: 197-202(Sept. 1964).

Isotopic ratios of ^{238}Pu, ^{239}Pu, ^{240}Pu, and ^{241}Am in a plutonium sample were approximately determined by means of combined α and γ spectrometry without chemical separation of americium from plutonium. The intensity of α ray followed by internal conversion was determined by measuring the intensity of LX-rays. The ratio of ^{240}Pu to ^{239}Pu was obtained from the ratio between the α-ray intensity thus determined and the total α-ray intensity from the two nuclides. (auth)

43403 DETERMINATIONS OF CHARGES ON IONS IN SOLUTIONS BY DONNAN MEMBRANE EQUILIBRIUM. Richard M. Wallace (E. I. du Pont de Nemours & Co., Aiken, S. C.). J. Phys. Chem., 68: 2418-23(Sept. 1964).

A method was developed for determining the charge of cations dissolved in perchloric acid solutions by measuring the concentrations of the ions on opposite sides of a permselective membrane in solutions of varying acidity. The method was applied to Na^+, Mg^{2+}, Ca^{2+}, Sr^{2+}, UO_2^{2+}, Al^{3+}, La^{3+}, Th^{4+}, and Ru(IV). The results agreed with the accepted values of the charge except for Ru(IV), on which a charge of +4 was found rather than +2, which had previously been reported. (auth)

43404 RADIOCHEMICAL STUDIES ON THE SEPARATION AND DETERMINATION OF PROTACTINIUM. Masanobu Sakanoue, Masumi Oosawa, Takashi Sakai, and Kouzi Ishida (Kanazawa Univ., Japan). Nippon Genshiryoku Gakkaishi, 6: 503-10(Sept. 1964). (In Japanese)

The separation and determination of ^{233}Pa produced in irradiated thorium were carried out by adding the aliquot of the ^{231}Pa stock solution (6N HCl – 0.1N HF) as tracer. Along with the co-precipitation method, solvent extraction of protactinium with the commercial di-isobutyl ketone was examined in hydrochloric acid system. The detailed studies were performed in regard to the effect of fluoride on the distribution ratio of protactinium between DIBK and 7.7, 6.7, and 5.7N HCl, respectively. The adequate Al/F ratio to mask fluoride was confirmed in the case of $AlCl_3$ addition. A suitable method for the preparation of counting source was studied and the final stripping solutions of extraction cycles were treated as follows. The 6N HCl – 0.1N HF solution was converted to 4N H_2SO_4 solution and protactinium was electro-deposited on the gold plated copper. The radiochemical quality of the sources was examined by spectrometry and decay curve. The β- and α-activities were measured and the correction for β counting rate was made in accordance with the contribution from ^{231}Pa to G-M counting. From the data, good agreement was obtained as to the amounts of ^{233}Pa/mgTh at the end of the irradiation. (auth)

43405 ACTIVATION ANALYSIS OF THORIUM IN SHELLS. Hiroshi Wakita and Kunihiko Kigoshi (Gakushuin Univ., Tokyo). Nippon Kagaku Zasshi, 85: 476-80(Aug. 1964). (In Japanese)

A procedure and some results of measurements of thorium contents in shell samples are reported. An analytical method of thorium is given for the neutron activation of shells, in which the β activity of ^{233}Pa is measured. ^{232}Th(n,γ)^{233}Th $\xrightarrow{\beta}$ ^{233}Pa $\xrightarrow{\beta}$. After irradiation, the sample is dissolved, ^{231}Pa is added as a carrier, Pa is then separated, purified from the irradiated sample by coprecipitations with $Fe(OH)_3$ and with MnO_2, and by DIBK extraction. Finally Pa is electrodeposited on platinum anode, and is counted with a proportional counter. The chemical yield of ^{233}Pa was ca 30%, which was determined by the yield of α activity of ^{231}Pa. It was found that the surface of shells was rich in thorium by the factor of greater than 10 ~ 40 compared with the inner part. The thorium seems to origi-

nate in secondary effect, ion exchange and/or adsorption. Therefore, the contents of thorium in shells varies with the part of shell, but the inner part of the shell gives relatively constant value of $2 \sim 8 \times 10^{-9}$ g Th/g. (auth)

43406 DETERMINATION OF ZIRCONIUM IN SEA-WATER. Tsunenobu Shigematsu (Kyoto Univ.), Yasuharu Nishikawa, Keizo Hiraki, and Heishiro Nakagawa. Nippon Kagaku Zasshi, 85: 490-3(Aug. 1964). (In Japanese)

Zirconium was determined in sea water by the fluorometric method with morin. Into 20 l of sea water, 20 ml of concentrated HCl and 200 mg of Al^{3+} as $AlCl_3$ solution were added and pH of the solution was adjusted to 8. After standing over night, the precipitate was filtered and dissolved in 50 ml of 3N HCl and the solution was evaporated to dryness. The residue was treated with 10 ml of 2N HCl and Zr was extracted with 10 ml of 0.2 M TTA-benzene solution. Zr-TTA-complex was then decomposed with $HClO_4$ and again evaporated to dryness. The residue was dissolved with 1.8 N HCl and the solution was transfered to a 25 ml volumetric flask. To the solution, 0.5 ml of 0.02% morin alcoholic solution was added. The solution was diluted to the volume with 1.8 N HCl. The fluorescence intensity of the solution was measured. In this procedure, the recovery of zirconium was found to be about 95%. Zr in sea-water collected at the offshore of Kuroshima, Wakayama Pref. and the cost of Misakicho, Osaka Pref., Japan was found to be 0.01 ~ 0.04 μg/l. Zr content in several marine animals and plants was also determined and found to be in the order of 10^{-4}% in ash samples. (auth)

43407 ACTIVATION DETERMINATION OF IMPURITIES IN ALUMINUM. IV. DETERMINATION OF VANADIUM AND NICKEL. W. Kiesl and F. Hecht (Reaktorzentrum, Seibersdorf, Austria and Universität, Vienna). Radiochim. Acta, 3: 48-50(Oct. 1964). (In German)

The determination of V and Ni in Al by activation analysis is described. Both elements are extracted with chloroform, V as nitrosophenyl-hydroxylamine complex from hydrochloric acid, Ni as the dimethylglyoximato complex from ammonia solution. The 1.40 Mev peak of ^{52}V and the 1.09 Mev peak of ^{65}Ni are used for the quantitative determination. (auth)

43408 ACTIVATION DETERMINATION OF SILVER IN MATERIALS WITH HIGH CADMIUM CONTENT. II. THE DEVELOPMENT OF IRRADIATION EXPERIMENTS. ANALYSIS OF TESTS. Franz Lux (Technische Hochschule, Munich). Radiochim. Acta, 3: 50-6(Oct. 1964). (In German)

To avoid disturbing nuclear reactions, Ag is electrolytically separated from Cd before neutron irradiation. After neutron activation, Ag with the ^{110m}Ag activity is dissolved from the platinum cathodes by nitric acid with silver carrier added, and the ^{110m}Ag activity is measured after radiochemical purification. For radiochemical purification, a combined precipitation procedure suited for this case was developed. Experiments with Ag^+/silver halide exchange did not yield the decontamination factors expected. In test runs, from 10^{-8} to 10^{-4} g Ag in 1 g Cd were analyzed with ±10% precision. Direct irradiation of original specimens showed an unexpected strong formation of ^{108}Ag and ^{105}Ag from Cd. Therefore, even hundred times greater silver contents have to be separated from Cd before neutron activation than had been calculated from literature data. (auth)

43409 INSTRUMENTAL ACTIVATION DETERMINATION OF URANIUM-238 OVER NEPTUNIUM-239. O. Bobleter and Ilse Musyl (Österreichische Hochschule, Vienna and Universität, Vienna). Radiochim. Acta, 3: 57-61(Oct. 1964). (In German)

In the instrumental activation analysis of uranium, the activity of the 0.106 Mev photons of the formed neptunium-239 was determined. It was demonstrated for the first time in 1957 that, after a comparatively short time of decay, the neptunium-239 could be measured without interference by the produced fission products. The sensitivity of the method was considerably increased by prolonging the duration of irradiation and counting. In a neutron flux of $0.7 \cdot 10^{12}$ n/cm^2 sec, 0.004 μg uranium could still be quantitatively determined in a solution. The influence of mineral components on the method of analysis was examined for pitchblendes. Of the numerous elements that are present in minerals containing pitchblende (Ca, Fe, Si, Al, Ni, Co, Ag, Bi, Au, Cu, Zn, Sb, and Mo), the only one that interferes in the concentrations to be expected is gold, by reason of its high activity, and its half life, which can be compared with that of neptunium-239. Using a South American pitchblende, it was demonstrated that the uranium determination could be easily carried out when gold was either completely absent or present in only a low concentration. The self-absorption of the soft 0.106 Mev gamma rays of neptunium-239 is negligible in average mineral samples of up to 200 mg/cm^2. (auth)

43410 ACTIVATION ANALYSIS OF THE DUTCH 50 c. STAMP OF 1867. J. Flegenheimer (Comisión Nacional de Energía Atómica, Buenos Aires). Radiochim. Acta, 3: 61-2(Oct. 1964).

Good and bad samples of this stamp, whose price changes considerably with the color variation, were activated in a neutron flux and the resulting activity analyzed. One day after a short irradiation the main activity is due to copper. The copper content is related to the quality of the color and this permits an evaluation of this stamp by activation analysis. (auth)

43411 ACTIVATION DETERMINATION OF LITHIUM USING THE REACTION CHAIN $^6Li(n,\alpha)^3H$ AND $^{16}O(t,n)^{18}F$. D. C. Aumann and H. J. Born (Technische Hochschule, Munich). Radiochim. Acta, 3: 62-73(Oct. 1964). (In German)

Using the reaction chain $^6Li(n,\alpha)^3H$, $^{16}O(t,n)^{18}F$ an activation analysis of Li was worked out whose detection limit is 0.01–0.02 ppm (10^{13} n/sec cm^2). A survey of possible disturbing reactions after reactor irradiation is given. The method works only with oxygen present. Possibilities to treat oxygen-free substances are discussed. The matrix effect, due to different triton ranges in different samples and to their various oxygen contents, which would require standard specimens of the same composition as the samples, can be accounted for by calculation. Analysis directions and numerous results of test analyses are given. (auth)

43412 A CONVENIENT CARRIER-FREE SEPARATION OF NIOBIUM FROM ZIRCONIUM. S. J. Lyle and A. D. Shendrikar (Univ. of Durham, Eng.). Radiochim. Acta, 3: 90-2(Oct. 1964).

A solvent extraction method is presented for the separation of ^{95}Nb in a carrier-free form from Zr. Nb is extracted into a chloroform solution of N-benzoyl-N-phenylhydroxylamine from an aqueous hydrochloric acid phase 0.05M in hydrofluoric acid. By following the recommended procedure a decontamination factor of about 10^4 from Zr is achieved and up to 1 mg per ml of Zr in the aqueous phase does not impair the separation. The Nb may be back extracted into aqua regia, ammoniacal hydrogen peroxide,

or aqueous ammonia, from all of which aqueous solutions of different chemical compositions can readily be prepared. The complete procedure need not take longer than 30 minutes. (auth)

43413 CONSECUTIVE CHELATOMETRIC MICRODETERMINATION OF SCANDIUM AND THE SUM OF OTHER RARE EARTHS. Shui-chieh Hung and Shu-chuan Liang (Inst. of Chemistry, Peking). Sci. Sinica (Peking), 13: 1619-23(Oct. 1964).

Less than 1 mg of scandium can be titrated in a porcelain crucible with disodium salt of ethylenediaminetetraacetic acid (EDTA), using xylenol orange as indicator. For titrations of 1–400 μg of scandium oxide, the relative errors lie within the range of +0.8 to –2.1%. This indicator is good for the consecutive chelatometric titrations of microgram-amounts of scandium and milligram-quantities (0.1–20 mg) of the other rare earths. The scandium titration is carried out at pH 1.8–2.2, and the light lanthanons together with yttrium, at pH 5.0–5.5 after adding hexamethylene tetramine. Light lanthanons up to 25 mg do not interfere with the scandium titration, while larger amounts of light lanthanons and yttrium can be masked with sulfosalicylic acid. Interference of ceric cerium can be minimized by reducing it to the cerous state. The relative errors for titrating consecutively microgram-quantities of scandium and milligram-quantities of light lanthanons are ±1% and 0–1% respectively. The effect of diverse ions is given. (auth)

43414 ANION EXCHANGE SEPARATION OF RUBIDIUM AND CAESIUM WITH METHYL ALCOHOL– NITRIC ACID AS ELUENT. Yi-liang Sun and Lan-chiang Lue (Peking Univ.). Sci. Sinica (Peking), 13: 1635-40(Oct. 1964).

The distribution coefficients of rubidium and cesium between the strong base anion exchange resin Zerolit FF (nitrate form) and nitric acid and alcohol mixed solvents of various ratios were determined with the elution method. The distribution coefficient in n-butyl alcohol was smaller than that in methyl alcohol. In the mixed solvents tested the distribution coefficient for cesium was always smaller than that for rubidium. The separation factor lies between 1.1 and 1.3. A separation of several hundred micrograms of rubidium and a trace amount of cesium was accomplished with a column (0.39 × 78 cm) filled with Zerolit FF of 200–300 mesh. (auth)

43415 RADIOMETRIC TITRATIONS. T. Braun (Loránd Eötvös Univ., Budapest) and J. Tolgyessy. Talanta, 11: 1277-1312(Sept. 1964).

A review is presented on the basis, possibilities in, and the present state of radiometric titrations. Several papers published in less readily available journals, or not available at all, are covered in a relatively detailed manner. 87 references published from 1941 through 1963 are included. (P.C.H.)

43416 COLORIMETRIC DETERMINATION OF VANADIUM WITH XYLENOL ORANGE. Omortag Budevsky and Rudolf Přibil (Polarographic Inst., Prague). Talanta, 11: 1313-18(Sept. 1964).

A highly selective colorimetric method for vanadium,$^{(V)}$ based on its color reaction with Xylenol Orange, is described. In the presence of 1,2-diaminocyclohexanetetraacetic acid (DCTA) this method is almost specific for vanadium, because other elements are screened, and do not interfere in moderate amounts. (auth)

43417 SUCCESSIVE DETERMINATION OF THORIUM AND RARE EARTHS BY COMPLEXOMETRIC TITRATIONS. Asim K. Gupta and Jack E. Powell (Ames Lab., Ames, Iowa). Talanta, 11: 1339-42(Sept. 1964). (IS-857)

Thorium can be determined quantitatively by EDTA in the presence of the light rare earths but not in the presence of the heavy rare earths. The successive determination of thorium and heavy rare earths with diethylenetriaminepentaacetic acid (DTPA) was found to be feasible and is described. The direct successive determination of thorium and rare earths by combined titration with DTPA and N-hydroxyethylethylenediaminetriacetic acid (HEDTA) is also discussed. (auth)

43418 SPECTROPHOTOMETRIC DETERMINATION OF MANGANESE WITH THENOYLTRIFLUORACETONE. Hiroshi Onishi and Yukio Toita (Japan Atomic Energy Research Inst., Tokyo). Talanta, 11: 1357-64(Sept. 1964).

A new spectrophotometric method for the determination of microgram amounts of manganese with thenoyltrifluoracetone (TTA) is described. After oxidation with sodium bromate, manganese (presumably tervalent) is extracted with 0.5M TTA in xylene from a 0.5M sulfuric acid solution. The absorbance of the organic phase is measured at 440 or 450 mμ. Beer's law is followed up to 10 μg of manganese/ml of organic phase. Except for cerium, iron, and chloride, small amounts of many common elements do not interfere. Iron(III) can be removed by cupferron-chloroform extraction, and cerium by washing the TTA extract with an ammonium hydrogen fluoride-nitric acid solution. (auth)

43419 AN INVESTIGATION OF FAST NEUTRON ACTIVATION ANALYSIS FOR DETERMINATION OF OXYGEN IN METALS. William F. Harris (Westinghouse Electric Corp., Pittsburgh). Talanta, 11: 1376-80(Sept. 1964).

A comparison was made between results obtained for the oxygen content of metals obtained by vacuum fusion and fast neutron activation over the range 0.0008–0.1% oxygen. The metals investigated included iron, silicon–iron, aluminum, molybdenum, niobium, and niobium-base alloys. The problems encountered in the use of activation analysis for oxygen are discussed and solutions are suggested. (auth)

43420 SOME RATHER UNUSUAL CHEMICAL ANALYSES. James O. Hibbits (General Electric Co., Cincinnati) and Silve Kallmann. Talanta, 11: 1443-8(Oct. 1964).

Some rather unusual chemical analyses are described. A typical example is the determination of a few μg of one element in a sample composed essentially of the elements listed in the periodic table. This somewhat bizarre sample is a solution containing 10 mg each of about seventy different elements. (auth)

43421 ANALYSIS OF POLYPHENYL MIXTURES BY THIN-LAYER CHROMATOGRAPHY. II. QUANTITATIVE WORK. F. J. Ritter, P. Canonne, and F. Geiss (Zentrallaboratorium TNO, Delft, Netherlands). Z. Anal. Chem., 205: 313-24(1964). (In German)

Quantitative analysis of mixtures of polyphenyls was achieved by chromatographic separation on thin-layers of alumina G using n-heptane as the mobile phase, extraction of the separated spots by n-heptane or methylene chloride and spectrophotometric determination of the extracted compounds. (auth)

43422 DETERMINATION OF SMALL QUANTITIES OF GOLD AND RHENIUM IN ROCK SPECIMENS BY NEUTRON ACTIVATION. Ts. M. Dvukhbabnaya, E. M. Lobanov, I. A. Mironskii, V. P. Pozychanyuk, D. G. Saifutdinova,

and A. A. Khaidarov (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Zavodsk. Lab., 30: 822-4(1964). (In Russian)

Gold and rhenium were determined in complex rocks by measuring the induced γ spectra without preliminary chemical separation of the isotopes formed by the (n,γ) reaction. The sensitivity of the method is 5×10^{-5}% for Au and 10^{-3}% for Re with an order of accuracy of 10 and 8%, respectively. (R.V.J.)

43423 DETERMINATION OF MERCURY IN ENRICHMENT PRODUCTS BY MEANS OF NEUTRON ABSORPTION METHOD. I. N. Plaksin, N. G. Malysheva, and L. P. Starchik (Skochinskii Inst. of Mines, USSR). Zavodsk. Lab., 30: 824-5(1964). (In Russian)

The large cross sections for (n,γ) reactions and the relatively large activation cross sections for ^{202}Hg and ^{204}Hg were used for determining mercury content in enrichment products. The mean order of error was 2 to 10% for a 10-min observation. During 20 min the relative error dropped to 1.5 to 2%. (R.V.J.)

43424 A RADIOMETRIC METHOD FOR THE ISOTOPIC ANALYSIS OF MIXTURES OF ^{141}Ce AND ^{144}Ce, ^{89}Sr AND ^{90}Sr IN SAMPLES OF LOW TOTAL ACTIVITY. S. V. Belov and N. V. Sidorov. Zh. Analit. Khim., 19: 1049-52(1964). (In Russian)

A method is described for the isotopic analysis of mixtures of ^{141}Ce and ^{144}Ce and ^{89}Sr and ^{90}Sr using a scintillating β spectrometer and 4π-counter. Rigid spectra of ^{144}Pr and ^{90}Y are used correspondingly to measure the activity of ^{144}Ce and ^{90}Sr. The activity for ^{141}Ce and ^{89}Sr was found by the difference between the total activity of the sample measured by 4π-counter and the activity of $^{144}Ce \rightarrow {}^{144}Pr$ and $^{90}Sr \rightarrow {}^{90}Y$ correspondingly. When samples of low total activity (about 1000 disintegrations per minute) are analyzed the method suggested has considerable advantages over the method of analysis of absorption curves in aluminum filters (the β particles recording is more effective and the results obtained are more accurate). (auth)

43425 SPECTROPHOTOMETRIC STUDY OF ORGANIC REAGENTS FOR SCANDIUM. A. I. Cherkesov and N. M. Alykov (Saratov State Pedagogical Inst., USSR). Zh. Analit. Khim., 19: 1067-72(1964). (In Russian)

Spectrophotometric characteristics of six reagents forming colored compounds with scandium were studied, absorption spectra of the molecular and ionic forms of the reagents and their compounds with scandium were taken molar extinction coefficients were found, and values of oscillating charges were calculated. Dissociation constants of the ionized forms of the reagents were also found. The composition of the complex compounds formed was determined by the two methods and their unstability constants were calculated. It was established on the basis of the experimental data that the best reagents for the spectrophotometric determination of scandium are stilbene-2,2′-disulfonic acid-4,4′-bis[(azo-2″)-1,8-dihydroxynaphthalene-3,6-disulfonic acid] and sulfonazo. (auth)

43426 THE USE OF CINNAMIC ACID IN ANALYTICAL CHEMISTRY. COMMUNICATION 6. PRECIPITATION OF SCANDIUM AND ITS SEPARATION FROM MANGANESE, NICKEL, COBALT AND ZINC. E. A. Ostroumov and I. I. Volkov (Inst. of Oceanology, Moscow). Zh. Analit. Khim., 19: 1073-7(1964). (In Russian)

It was established that ammonium cinnamate quantitatively precipitates scandium from a weakly acid solution in the presence of ammonium salts on heating. The precipitate has no constant composition: scandium is precipitated mainly as neutral cinnamate $(C_6H_5CH:CHOO)_3Sc$ with admixtures of basic cinnamates containing different anions depending on the nature of the solution (chlorides, nitrates or sulfates). The precipitates obtained are calcined to Sc_2O_3 and weighed. By precipitating scandium with ammonium cinnamate it can be separated from manganese, nickel, cobalt, and zinc. (auth)

43427 ON THE SENSITIVITY OF A METHOD FOR DETERMINING BORON IN A SILICON BY NEUTRON CAPTURE REACTIONS. E. M. Lobanov, V. I. Zvyagin, B. P. Zverev, and D. I. Blinkov. p.64-73 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

The problem of determining small amounts of boron in silicon is reviewed. Chemical concentration followed by mass-spectrometric analysis can be used to determine boron to 10^{-8}%, but complex equipment and high vacuum are required. The boron content can also be determined from measurements of the Hall constant and the electrical conductivity of the silicon sample, but these methods are not definite for use with boron. Natural boron contains 18.5% ^{10}B which reacts with thermal neutrons by a $^{10}B(n,\alpha)^7Li$ reaction (4000 barn cross section for the reaction). The ^{7}Li emits a 479-kev γ ray, which can be counted on a multichannel scintillation counter in order to determine the boron content in the silicon. The detection limit of boron is estimated to be 10^{15} atoms cm^{-3}, which is 1 to 2 orders of magnitude higher than other methods used at present to detect boron. The 1.47-Mev α particle and the 0.88-Mev ^{7}Li nucleus can be determined by using special nuclear film emulsion or by converting the silicon sample to a surface-barrier transistor, which can be used to count charged particles. Measures must be taken to remove hydrogen from the silicon sample because of interference due to the occurrence of hydrogen recoil atoms. The sensitivity of this method of determining boron can attain a value of 10^{14} atoms cm^{-3}. (TTT)

43428 THE PROBLEM OF DETERMINING A LOW CONCENTRATION OF BORON IMPURITY IN SILICON. E. M. Lobanov, V. I. Zvyagin, and B. P. Zverev. p.74-6 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

It was found to be possible to determine a low concentration of boron in silicon by making an n-p transistor of the silicon sample and counting the 1.47-Mev α particles and 0.88-Mev ^{7}Li nuclei, which are obtained by $^{10}B(n,\alpha)^7Li$ reactions (cross section of 4000 barns) on irradiating the transistor with thermal neutrons. Determination of the effective volume represents a basic difficulty in the use of this method, since the magnitude of the pulse created by the ionizing particles must be calculated as a function of position of the ionization event with respect to the n-p transistor. It was found that the effective volume is the area of the n-p transistor multiplied by the diffusion length L of the ionizing particles. The concentration of boron in the silicon is calculated from the following formula: $K = [n/I\sigma V_{eff}f]$. Here K is the concentration of boron in atoms cm^{-3}; n is the number of pulses counted per second by the silicon transistor due to the products of the $^{10}B(n,\alpha)^7Li$ reaction; I is the neutron flux in neutrons/cm^2 sec; σ is the cross section of the $^{10}B(n,\alpha)^7Li$ reaction in cm^2; V_{eff} is the effective volume in cm^3, and f is the abundance of the ^{10}B isotope in nature (f = 0.185). The concentration of boron was found to be 10^{14} atoms cm^{-3} for an n-p silicon

transistor formed by diffusing aluminum into n-type silicon with a specific resistance of 60 ohm-cm and a lifetime of minority charge carriers of ~100 μsec. (TTT)

43429 DETERMINATION OF IMPURITIES IN MONOCRYSTALLINE GERMANIUM BY THE METHOD OF ACTIVATION ANALYSIS. E. M. Lobanov, V. I. Zvyagin, A. A. Kist, A. I. Sviridov, Yu. Evseenko, and G. A. Moskovtseva. p.77-83 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

The Ge sample was first irradiated for 5 minutes in the thermal column of the reactor at a neutron flux of 1.8×10^{12} neutrons/cm^2 sec. An analysis of the γ spectrum on a 100-channel analyzer equipped with NaI (Tl) crystal showed that the Al impurity was $<10^{-6}$ % in the Ge sample. Samples of Ge and standard samples of In, Ga, and Sb were irradiated for 8 hours at a neutron flux of 1.8×10^{13} neutrons/cm^2 sec. The standard irradiated samples were purified by chemical treatment. In the irradiated Ge sample, germanium was first distilled off as the chloride, and then arsenic was also distilled as $AsCl_3$. Then Sb was precipitated as the sulfide from 1 to 4N HCl, and further purified from Ga and In. The In was separated from the In and Ga mixture by extracting from 3N HBr with diethylether, and the In was finally isolated as the oxyquinolate. Finally Ga was isolated by extracting from 6N HBr with diethyl ether. The γ spectrum showed that sharp radiochemical separations were obtained. The beta decay curves were the same for the Sb and Ga standards, and for the Sb and Ga fractions isolated from the irradiated Ge crystals. The results showed that these were 3.8×10^{16} Sb atoms and 1.1×10^{17} Ga atoms per cm^3 of Ge sample. Irradiation of a pure Ge sample showed that ^{72}Ga is formed by an (n,p) reaction on ^{72}Ge. The experimental cross section for the ^{72}Ge(n,p)^{72}Ga reaction was found to be 1.3×10^{-2} mb, which is close to the theoretical value of 1.5×10^{-2} mb for 4-Mev neutrons. (TTT)

43430 GAMMA SPECTROMETRIC METHOD FOR DETERMINING LANTHANUM AND SAMARIUM IN MINERALS. A. Babaev and E. M. Lobanov. p.89-94 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

The content of La and Sm in monazite, davidite, orthite, and euxenite were determined by irradiating 200 to 500 μg samples of these minerals for a period of 10 minutes at a neutron flux of 1.8×10^{13} neutrons/cm^2 sec. The effective activation cross sections were 8.4 barns for ^{139}La and 150 barns for ^{152}Sm. The contents of ^{140}La, with a half life of 40 hours, and of ^{153}Sm, with a half life of 47 hours, could be determined by γ scintillation counting with a NaI(Tl) crystal. No preliminary radiochemical separations were required. The contents of La and Sm in the mineral were obtained by comparing the La and Sm activities in the sample with the La and Sm activities found in known amounts of La and Sm standards. The sensitivity of the method could be increased even further by irradiating the mineral samples at even higher neutron fluxes. This method can be used to determine microamounts of rare earth elements in various minerals and concentrates. (TTT)

43431 ON THE PROBLEMS OF DETERMINING GOLD IN ORES AND ROCKS. E. M. Lobanov, I. A. Miranskii, V. F. Pozychanyuk, D. G. Saifutdenova, and A. A. Khaidarov. p.95-100 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

The determination of 0.5 to 40 g of Au/ton by a neutron activation analysis based on the ^{197}Au(n,γ)^{198}Au reaction is difficult due to the presence of large amounts of Na, As, and Fe in most mineral samples. The 412-kev peak of ^{198}Au can be readily separated from the 550-kev peak of ^{76}As, the 1100- and 1290-kev peaks of ^{59}Fe, and the 1370- and 2740-kev peaks of ^{24}Na, but the Compton scattering background contribution from these interfering induced activities limits the accuracy of a gold determination in a mineral sample. The accuracy of the gold analysis can be considerably improved by volatilizing off the arsenic by arc heating 20 mg of sample at a current strength of 8 amps for 30 seconds, and then irradiating the heated carbon. The As content in the sample is decreased by a factor of 120 (0.8% of its original content). A gold content of 0.5 g/ton and higher can thus be readily analyzed by neutron activation, even if large amounts of arsenic, sodium, and iron are present in the sample. A number of samples containing 0.5 to 40 g of Au/ton were analyzed by neutron activation and by chemical methods. The average deviation of the analyses was ±12%. Thus, the gold content of ores can be determined without the necessity of a radiochemical separation. The samples must be allowed to decay 1 to 6 days, but 100 or more samples can be run simultaneously. (TTT)

43432 ON THE DETERMINATION OF GOLD CONTENT IN ORES BY NEUTRON ACTIVATION ANALYSIS. E. M. Lobanov, I. A. Miranskii, M. M. Romanov, and A. A. Khaidarov. p.101-7 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Because of a high activation cross section of 1560 barns for the ^{197}Au(n,γ)^{198}Au reaction, a relatively long half life of 64.5 hours for the radioactive ^{198}Au product, and an intense 412-kev γ ray from ^{198}Au, it is possible to analyze ores having a low content of gold without performing a radiochemical separation. A multichannel analyzer is used to determine the height of the 412-kev peak of ^{198}Au. The activities induced in a 10-g ore sample irradiated 9 hours at a neutron flux of 1.8×10^{13} neutrons/cm^2 sec were tabulated, and the decay of these activities was plotted. After 50 hours decay, the ^{65}Ni, ^{31}Si, ^{56}Mn, ^{72}Ga, and ^{69}Zn activities were much less than the ^{198}Au activity. The ^{64}Cu, ^{42}K, and ^{24}Na activities became negligible after 200 hours decay. The 412-kev peak of ^{198}Au could be separated from the 550-kev peak of ^{76}As on a good scintillation spectrometer after 390 hours of cooling time. A number of ore samples containing 5 to 50 g of Au/ton were analyzed by neutron activation and also by chemical analysis. The deviation was ±12% on the average. (TTT)

43433 INVESTIGATION OF GAMMA SPECTRA OF NEUTRON CAPTURE BY ORE SPECIMENS. E. M. Lobanov, M. M. Romanov, and A. A. Khaidarov. p.108-10 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Samples of minerals were exposed to a collimated beam of thermal neutrons from a reactor, and the capture γ rays from 2 to 10 Mev were recorded on a multichannel analyzer equipped with a NaI(Tl) crystal 40 × 40 mm and a photomultiplier. The γ background was subtracted from the spectra. A total of 10 mineral samples were irradiated, and the results showed that the capture γ spectra for the minerals are all different, and are characteristic of the mineral. A mineral can be identified by comparing its capture γ spectrum with the γ spectra of standard samples. This activation method can be used in the place of the older method of chemical analysis for the identifica-

tion of minerals, especially those which are difficult to identify by the usual methods. An atlas of capture, γ spectra is being prepared for most of the known minerals. (TTT)

43434 DETERMINATION OF MERCURY IN ORES AND CONCENTRATES BY GAMMA SPECTROMETRY OF RADIATIVE NEUTRON CAPTURE IN THE HORIZONTAL CHANNEL OF VVR-S. E. M. Lobanov, M. M. Romanov, and A. A. Khaidarov. p.111-15 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Mercury ores containing 0.01 to a few percent of Hg were exposed to a collimated beam of thermal neutrons from a reactor. The capture cross section of Hg (380 barns) was about 3 orders of magnitude greater than the other elements accompanying the Hg. The intensity of the capture γ rays was determined on a multichannel γ spectrometer equipped with a NaI(Tl) crystal 40×40 mm and a photomultiplier. A 15-g ore sample was exposed to a neutron flux of 10^7 neutrons/cm^2 sec. The intensities of the peaks at 3.81, 4.31, and 4.91 Mev were used to measure the Hg content in the ore. The sensitivity of the method is ~0.1% Hg, and the accuracy of the method is 10% on the average. On the basis of preliminary results, it was concluded that it should be possible to determine the Hg content of ores directly in bore holes by neutron activation logging. (TTT)

43435 A NEW METHOD OF INTERPRETING TWO-COMPONENT CURVES WHICH INCLUDES THE DECAY OF AN INDUCED ACTIVITY AND WHICH TAKES INTO ACCOUNT THE BACKGROUND OF LONG-LIVED ISOTOPES. E. M. Lobanov, A. P. Novikov, S. G. Nikanorov, and A. A. Khaidarov. p.138-44 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

The relative amounts of ^{28}Al ($T_{1/2}$ = 2.3 min), ^{66}Cu ($T_{1/2}$ = 5.1 min), ^{52}V ($T_{1/2}$ = 3.9 min), ^{27}Mg ($T_{1/2}$ = 9.4 min), ^{64}Cu ($T_{1/2}$ = 12.9 hr), ^{24}Na ($T_{1/2}$ = 14.9 hr), and other activities were tabulated for a 15 minute neutron irradiation of a disseminated copper ore. The Cu content was determined by finding the height of the 1.06-Mev γ line of ^{66}Cu. The concentrations of V, Mg, and Mn in the ore samples were low, and did not interfere with the Cu determination. However, the amount of induced ^{28}Al activity was considerable, and a nomogram was constructed to give the ^{66}Cu activity from the "apparent" half life of a ^{28}Al + ^{66}Cu mixture of activities. A nomogram is also given for the long-lived background associated with an initial induced activity I_0, and a certain apparent half life t. These nomograms can be used to determine the Cu content of an ore from the activity induced in the sample by neutron irradiation. (TTT)

43436 A DEVICE FOR AUTOMATIC ANALYSIS OF TWO-COMPONENT ISOTOPIC MIXTURES WITH NEARLY IDENTICAL HALF LIVES INVESTIGATED BY DIRECTED ACTIVITY METHOD. E. M. Lobanov, A. P. Novikov, A. A. Khaidarov, and A. I. Chernyshev. p.145-8 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

The induced ^{28}Al activity having a γ energy of 1.78 Mev and a half life of 2.3 min interferes with the gamma spectrometry of ^{66}Cu having a γ energy of 1.04 Mev and a half life of 5.1 minutes. If it is assumed that the Compton scattering contribution to the 1.04-Mev peak of ^{66}Cu is constant and depends only on the amount of ^{28}Al present, it is possible to estimate this contribution by counting the 1.78-Mev peak of ^{28}Al. A circuit was devised, where the 1.04-Mev peak from a ^{66}Cu and ^{28}Al mixture was counted, and a correction was automatically applied that depended on the amount of ^{28}Al present, as estimated from the height of the 1.78-Mev peak. The percent Cu content was read directly from the curve. The same principle was used in correcting for the Compton scattering contribution of the 1.37-Mev γ ray of ^{24}Na ($T_{1/2}$ = 14.5 hr) to the 0.51-Mev γ peak of ^{64}Cu ($T_{1/2}$ = 12.9 hr). The radiation contribution of the second component (^{28}Al or ^{24}Na) was automatically taken into account by introducing a compensating circuit (a discriminator) and integrator into the circuit of the γ spectrometer. (TTT)

43437 ADVANCES IN ANALYTICAL CHEMISTRY AND INSTRUMENTATION. VOLUME 3. Charles N. Reilley, ed. New York, Interscience Publishers, 1964. 529p.

Recent developments in analytical chemistry and instrumentation are reviewed. Topics covered include: atomic absorption spectroscopy, photometric titration, analytical applications of enzyme-catalyzed reactions, ion sources and detectors for the mass spectroscopic study of solids, galvanic analysis, linear elution adsorption chromatography, concepts and column parameters in gas chromatography, and thin-layer chromatography. A separate abstract was prepared for the paper on the first topic. (M.C.G.)

For an abstract of the individual paper see: 43438.

43438 ATOMIC ABSORPTION SPECTROSCOPY. R. Lockyer (Hilger and Watts, Ltd., London). p.1-29 of "Advances in Analytical Chemistry and Instrumentation. Vol. 3." New York, Interscience Publishers, 1964.

Principles of atomic absorption spectroscopy, source of radiation, choice of absorption time, population of atoms, measurement of attenuation, applications, interferences, and future prospects for the method are discussed. (M.C.G.)

43439 DETERMINATION OF RADIOCHEMICAL PURITY BY MEANS OF AUTORADIOGRAPHY. Ruth Grennen Tsuk, Th. Castro, L. Laufer, and D. R. Schwarz (Schwarz Bio Research, Inc., Orangeburg, N. Y.). p.497-509 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Autoradiography of paper chromatograms provides a relatively simple and precise method for determining radiochemical purity of biochemicals labeled with ^{14}C and ^{3}H. Techniques developed for this purpose are discussed. Particular attention was directed to sources of artifacts and means for avoiding them. Applications to standardization and shelf-life studies of labeled amino acids and nucleic acid precursors are presented. (auth)

Inorganic and Physical Chemistry

43440 (ANL-6800(p.305-25)) CALORIMETRY. W. N. Hubbard and H. M. Feder (Argonne National Lab., Ill.).

The technique that was developed for combustions of Zr and U in F_2 was used for combustions of Nb, Ta, and Ru. The following standard enthalpies of formation of the pentafluorides in kcal mole^{-1} were obtained: NbF_5, −433.5; TaF_5, −455.1; and RuF_5, −213.4. Additional measurements were made of the energy of combustion of ZrB_2 in F_2. Attempts were made to obtain more accurate results. Final interpretation of the results is incomplete. The same technique used for the studies with ZrB_2 was also used for a series of combustions of NbB_2 in F_2.

Preliminary determinations of the heat of combustion of NbB_2 in F_2 are presented. A method was developed for combustions of SiC in F_2, in which method the sample is confined to the center of a flat Ni disk by a Ni ring. Calorimetric combustions were started. Several approaches are being considered for the auxiliary determination of the enthalpy of formation of tetrafluoromethane. A new technique for the combustion of Th in F_2 was developed which appears to be satisfactory: The sample is suspended at the top of the bomb during the initial stage of combustion. After combustion has proceeded to the point that the suspension wire parts, the burning sample falls onto a ½-in.-layer of compacted fluoride powder on the bottom of the bomb. Preliminary experiments are being carried out for the combustion of US in F_2. Several different means are being investigated for preventing premature reaction of the sample. Assembly and testing of the 1500°C drop calorimeter is continuing. Shielding for the furnace is being redesigned; a Cu-block calorimeter was built and is being put into operation; the gate system was assembled; and work is in progress on the assembly of the drop mechanism. Design of the complete furnace and drop mechanism for the 2500°C drop calorimeter is complete, and construction was started. (auth)

43441 (ANL-6855) THE CRYSTAL STRUCTURE OF DISODIUM TETRANITRITONITROSOHYDROXYRUTHENATE(III) 2-HYDRATE BY NEUTRON DIFFRACTION. Final Report — Program 4.10.22. M. H. Mueller (Argonne National Lab., Ill.) and S. H. Simonsen (Texas. Univ., Austin). July 1964. Contract W-31-109-eng-38. 67p.

The crystal structure of $Na_2[Ru(NO_2)_4(NO)(OH)] \cdot 2H_2O$ was investigated by neutron diffraction, and the positional parameters of the heavy and light atoms were determined. The unit cell is monoclinic: $a_0 = 12.75$; $b_0 = 14.52$; $c_0 = 7.37$ Å; $\beta = 121.20°$. The space group is C2/m, with 4 molecules (100 atoms) per unit cell and systematic absences are $h+k = 2n+1$. The structure can be considered as consisting mainly of 6-fold coordination about three central atoms, namely, Ru, Na_1, and Na_2, forming three different kinds of octahedra. These octahedra form an interlocking chain throughout the structure, in which common atoms or common edges are shared between the octahedra. The 6-fold coordination about the ruthenium consists of four nitrogens of the nitrito groups arranged in a square, the nitrogen of the nitroso, and the oxygen of the hydroxyl group. These ruthenium octahedra are held together by Na–O bridges involving 6-fold coordination about the two crystallographically different sodium atoms. Hydrogen bonding apparently is not important in this crystal. (auth)

43442 (ASD-TDR-63-789) THE USE OF INFRARED ABSORPTION SPECTROSCOPY IN RESEARCH ON HAFNIA AND ZIRCONIA. William L. Baun and Neil T. McDevitt (Research and Technology Div. Air Force Materials Lab., Wright-Patterson AFB, Ohio). July 1963. 16p. (AD-422032)

Infrared spectra are shown for monoclinic ZrO_2 and HfO_2 and cubic stabilized ZrO_2 and HfO_2. Nine to ten bands in the region 800–200 cm^{-1} are reported for the monoclinic modification of each, while the stabilized cubic phases show only one broad band over the same frequency range. Both cubic and monoclinic ZrO_2 spectra are qualitatively similar to corresponding phases in HfO_2, but small differences in band position and shape make identification and separation possible in the monoclinic phase of these compounds. The spectrum of tetragonal ZrO_2 (CeO_2 stabilized) is identical to spectra obtained from cubic ZrO_2 samples. The strong dependence of the infrared spectrum on structure and lattice impurities is shown in the spectrum of a monoclinic specimen prepared by heating a low-temperature stabilized sample at 800°C. (auth)

43443 (IA-968) CATION EXCHANGE WITH MOLTEN SALTS. II. THE SODIUM–SILVER EXCHANGE. M. Liquornik and Y. Marcus (Israel. Atomic Energy Commission. Soreq Research Establishment, Rehovoth). July 1964. 12p.

The cation exchange between the zeolite Linde Molecular Sieve 4A in sodium form, and silver–sodium nitrate melts was investigated at 325–330°C. The progress of the reaction was followed potentiometrically, using a silver electrode. The thermodynamic constant for the exchange reaction was found to be 14.8 ± 1.5. Activity coefficients for the components of the zeolite were calculated. It is believed that the exchange reaction proceeds in two stages. First, silver nitrate replaces part of the occluded sodium nitrates in the pores of the zeolite, and then silver ions are exchanged for sodium ions at the exchange sites. (auth)

43444 (LA-3132-MS(p.233-5)) NUCLEAR MAGNETIC RESONANCE STUDIES ON NUCLEOTIDES. C. T. Gregg (Los Alamos Scientific Lab., N. Mex.).

Techniques used in nuclear magnetic resonance studies on nucleotides are described. (C.H.)

43445 (ORNL-P-324) VOLTAMMETRIC MEASUREMENTS IN MOLTEN FLUORIDE SALT SYSTEMS. D. L. Manning, John M. Dale (Oak Ridge National Lab., Tenn.). Gleb Mamantov (Tennessee. Univ., Knoxville) and (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 25p. (CONF-742-1)

From 15th CITCE Meeting (International Committee on Thermodynamics and Electrochemical Kinetics), London, Sept. 1964.

Electroanalytical studies of reducible species in molten fluorides are being conducted. Controlled-potential voltammetry was utilized to study the electrochemical behavior of iron(II) and nickel(II) in molten LiF–NaF–KF (46.5–11.5–42 mole %) and also in molten LiF–BeF_2 (66–34 mole %). Iron and nickel are corrosion products which arise from the corrosive action of the molten fluorides on the metal containment systems. For the controlled-potential voltammetric studies, the melt (~40 ml) is contained in a graphite cell which is enclosed in a quartz jacket to maintain either a vacuum or a controlled atmosphere. Stationary dip-type indicator electrodes fabricated from platinum, silver, tungsten, and pyrolytic graphite were utilized. Pyrolytic graphite encased in boron nitride is the most satisfactory indicator electrode tested so far. Boron nitride, which is an insulator at the experimental temperatures (500-600°C), protects the layered edges of the "c" planes while permitting the impervious surface of the "a" plane to be exposed to the melt. Platinum electrodes were employed as quasi-reference and counter electrodes. Peak-shaped current-voltage curves were obtained for the reduction of iron and nickel when the rate of voltage scan was ~1 v/min and greater; this implies that diffusion rather than convection is the predominant mass transfer process under these experimental conditions. The half-wave potentials for the reduction of iron and nickel are approximately –0.6 and –0.2 v, respectively, vs the platinum quasi-reference electrode. The peak current is proportional to the con-

centration of the electroactive species in the melt and also to the square root of the rate of voltage scan. Diffusion coefficients of approximately 1×10^{-6} cm^2/sec were calculated for both species at 500°C; from a plot of log D vs 1/T, an activation energy (E) of about 12 kcal/mole and 18 kcal/mole was calculated for the reduction of iron(II) and nickel(II) to the metal, respectively, in molten LiF–NaF–KF. (auth)

43446 (RPI-2325-1) THE CRYSTAL AND MOLECULAR STRUCTURE OF AMMONIUM URANYL CUPFERRATE (thesis). Final Report. J. L. Katz and Wendell S. Arrington (Rensselaer Polytechnic Inst., Troy, N. Y.). Aug. 1964. Contract AT(30-1)-2325. 410p.

Submitted by Wendell S. Arrington.

Ammonium uranyl cupferrate (NH_4UCF) is obtained as a precipitate when solutions of cupferron and a soluble uranyl salt (e.g., $UO_2(NO_3)_2 \cdot 6H_2O$) react. NH_4UCF crystallizes in space group $P2_13$ with a = 13.341 ± 0.003 A and Z = 4. This complex is actually an ionic salt–the ammonium salt of the uranyl cupferrate, $UO_2(C_6H_5N_2O_2)_3^-$, anion. The investigation of NH_4UCF was undertaken primarily with the intention of gaining further knowledge about the structural chemistry of uranium. In NH_4UCF uranium forms two collinear and relative strong primary (uranyl) uranium–oxygen bonds. Six weaker secondary (chelate) uranium–oxygen bonds are also formed. To a very good approximation, the six secondary oxygens are at the vertices of a regular hexagon centered at the uranium and in the plane perpendicular to the uranyl axis. Diffractometer data were obtained for a small NH_4UCF single crystal which had been ground into a sphere (r = 0.049 ± 0.002 mm). Intensities for a total of 975 reflections, all those with $2\theta \leq 160°$, were recorded. CuKα radiation with pulse height discrimination and nickel filtering was used. The data were corrected for Lp and absorption effects; the effect of anomalous dispersion was also taken into account. Least squares refinements of the coordinate and thermal parameters of all the individual atoms were carried out. Anisotropic least squares refinements using all 975 reflections led to a value of R = 0.082. Rather large deviations between F_c and F_0 were evident for forty-one of the 975 reflections. It was assumed that these deviations were caused by extinction and/or spurious absorption effects. The deletion of these forty-one reflections decreased R from 0.082 to its final value of R = 0.066. The highlights of the NH_4UCF structure are as follows: 1) The average U–O uranyl bond length is 1.77 ± 0.03A. 2) The U–O chelate bond lengths are 2.41 ± 0.02A and 2.47 ± 0.02A. 3) The angle of the N_2O_2 least squares plane with the uranyl axis ([111] cubic direction) is 6.29°. The maximum individual deviation from this plane is 0.007A. 4) The angle of the phenyl least squares plane with the uranyl axis is 5.75°. The greatest individual deviation from this plane is 0.207A. 5) The angle between the least squares planes of the N_2O_2 and phenyl groups is 7.16°. 6) The ammonium ion is surrounded nearly octahedrally by three cupferrate oxygens and three ortho carbon atoms at distances of 2.93A and 3.06A. A second set of three cupferrate oxygens surrounds the ammonium ion at a distance of 3.22A. Infrared spectra of NH_4UCF, cupferron, and other pertinent compounds have been obtained. These spectra and some tentative band assignments are presented. (D.L.C.)

43447 (TID-19201) INFRARED SPECTROSCOPY OF XENON COMPOUNDS. D. F. Smith (Oak Ridge Gaseous Diffusion Plant, Tenn.). [1963]. Contract W-7405-eng-26. 16p.

Infrared spectroscopy has been an important factor in the development of the new field of inert gas chemistry. A discussion is presented of some aspects of infrared spectroscopy in this field. Techniques employed in studying the Xe compounds are described, and their use in the study of XeF_2, XeF_4, XeF_6, and $XeOF_4$ is illustrated. The particular features of the spectrum and the molecular configuration are discussed. (D.L.C.)

43448 (UJV-1113/64) SUL'FAT BARIYA S ISKUSSTVENNO VVEDENNYMI DEFEKTAMI SUL'FATA KAL'TSIYA-SORBENT DLYA MIKROKOLICHESTV STRONTSIYA I RADIYA. (Barium Sulfate with Calcium Sulfate Impurities Acting as a Srobent for Microquantities of Strontium and Radium). L. Berak and Yan Myunikh (Ceskoslovenská Akademie Ved. Ustav Jaderného Výzkumu, Rez). [1961]. 19p.

A phase diagram was constructed for barium and calcium sulfates. It was found that strontium capture by barium sulfate can be increased by introducing calcium sulfate impurities. The structure of the barium sulfate is deformed, and during recrystallization the active sorption locations trap isomorphous cations forming mixed crystals. Such sorption is effective in solutions containing large quantities of calcium ions and can be applied for separating strontium from drinking water containing calcium. (R.V.J.)

43449 (ANL-Trans-81) ON THE NATURE OF PEROXIDE BONDS IN BINUCLEAR COBALTAMMINES. Wiktor Jakob and Maria Ogorzalek. Translated by Martha H. Kaski (Argonne National Lab., Ill.), from Roczniki Chem., 30: 1055-64(1956). 11p.

The first product of oxidation of Co^{2+} in ammonical solutions is the binuclear complex $[(NH_3)_5-Co-O_2-Co(NH_3)_5]^{4+}$. This so-called "oxo-cobaltiac" complex further decomposes to the "anhydroxycobaltiac" complex $[(NH_3)_5-Co-O_2-Co(NH_3)_5]^{5+}$. The decomposition of the oxo- and anhydro-complexes was studied. It is concluded that acid acts on the oxo-complex to produce $[Co_2O_2H(NH_3)_{10}]^{5+}$, which then loses one hydrogen atom to produce $[Co_2O_2(NH_3)_{10}]^{5+}$. In this anhydro-complex, both Co atoms are in the trivalent state, with the oxygen being a superoxide group O_2^-. (D.L.C.)

43450 (FTD-TT-64-471) INFRARED SPECTRA OF COMPLEX COMPOUNDS OF THORIUM, ZIRCONIUM, AND URANYL WITH 8-HYDROXYQUINOLINE AND TRIBUTYL PHOSPHATE. V. I. Gayvoronskii (Gayvoronskiy), O. A. Osipov, and R. R. Shagidullin. Translated from Radiokhimiya, 5: 244-8(1963). 10p.

The interactions of Zr, Th, and uranyl with oxine and of $ThCl_4$ and $ZrCl_4$ with tributyl phosphate, were studied using infrared absorption spectra. In the oxinates, an intensification of the conjugations in the aromatic ring was noted, and an excess molecule of oxine appears to be joined to the complex. The results for tributyl phosphate indicate the formation of complexes. (D.L.C.)

43451 (SC-T-64-1607) ACTION OF AMMONIA ON DIFFERENT SUPER-REFRACTORY OXIDES. Robert Collongues, Jean-Claude Gilles, and Anne-Marie Lejus. Translated by Marcel I. Weinreich (Sandia Corp., Albuquerque, N. Mex.), from Bull. Soc. Chim. France, 2113-17(1962). 12p.

The attack exerted by ammonia on the oxides of titanium, aluminum, and zirconium leads, according to temperature, to the formation of titanium and aluminum nitrides, or oxinitrides of aluminum and zirconium. The

conditions of reactive formations of solid oxinitrides of titanium are indicated. The study of zirconium and aluminum oxinitrides is reported. All the oxinitrides studied possess structures which are derived from the structures of the corresponding metal oxides. (auth)

43452 MEAN AMPLITUDES OF VIBRATION AND THERMODYNAMIC FUNCTIONS OF XENON TETRAFLUORIDE. G. Nagarajan (Oaklahoma State Univ., Stillwater). Acta Phys. Austriaca, 18: 11-19(1964).

The vibrational and molecular structural analyses for xenon tetrafluoride molecule possessing a square planar configuration with the symmetry point group D_{4h} are comprehensibly reported. The mean amplitudes of vibration at the temperatures T = 0 and T = 298°K were studied after evaluating the force constants. The molar thermodynamic functions were also calculated on the basis of a rigid rotator, harmonic oscillator approximation for the temperature range from 50 to 2000°K. (auth)

43453 TOTAL NEUTRON SCATTERING CROSS-SECTION STUDY OF MOLECULAR MOTIONS IN DIMETHOXYAZOXYBENZENE (p-AZOXYANISOLE). J. A. Janik (Inst. of Nuclear Physics, Krakow) and J. M. Janik. Acta Phys. Polon., 25: 845-8(June 1964).

Total neutron scattering cross sections vs neutron wave lengths were measured in the wave length region 5.84 to 7.40 Å for solid, liquid crystalline, and liquid di-methoxy-azoxybenzene. From the obtained slopes conclusions about a strong hindrance of rotation of CH_3-groups in the solid and about a weak hindrance of this rotation in both liquid phases were made. (auth)

43454 ADVANCES IN CHEMICAL PHYSICS. VOLUME VI. I. Prigogine, ed. New York, Interscience Publishers, 1964. 513p.

Information is included on the analytic theory of chemical reactions, thermodynamics of surface systems, the critical region, equation of state of the classical hard sphere fluid, macrodynamical theory of multicomponent fluid diffusion, ionic solvation, and melting mechanisms of crystals. Two chapters on electron gas in a lattice of positive charges and many-electron theory of atoms, molecules, and their interactions are abstracted separately in NSA. (P.C.H.)

For abstracts of individual chapters see: 43455 and 43456.

43455 ELECTRON GAS IN A LATTICE OF POSITIVE CHARGES. A. Bellemans and M. De Leener (Université Libre, Brussels). Advan. Chem. Phys., 6: 85-144(1964).

The properties of an electron gas moving in a lattice of positive charges at absolute zero are discussed. Information is included on general formalism, electron gas in a lattice of positive charges, electron gas in a one-component lattice, and multicomponent lattices. This corresponds roughly to actual metals or metallic solutions and in principle should furnish some new insight into the cohesive properties of pure metals and into the thermodynamic properties of mixing of alloys. (P.C.H.)

43456 MANY-ELECTRON THEORY OF ATOMS, MOLECULES AND THEIR INTERACTIONS. Oktay Sinanoglu (Yale Univ., New Haven). Advan. Chem. Phys., 6: 315-412(1964).

Calculation of the wave functions and energies of many-electron atoms and molecules is discussed. The properties of primary interest are: total energies, ionization potentials, electronic spectra, and dissociation energies of molecules; heats of formation, isomerization, and conformational changes of large molecules; and intermolecular forces over all ranges of separations. Both semi- and non-empirical schemes are considered. The objective is to make use of chemical simplifications in non-empirical molecular quantum mechanics (but not in ad hoc fashion), and also to have a quantitative basis for a semiempirical quantum chemistry. A theory was developed that should allow the binding energy of a heavy molecule such as Na_2 to be calculated by dealing with only its valence electrons and in almost the same way as in a James-Coolidge type H_2 calculation. 99 references are included. (P.C.H.)

43457 CHEMICAL REACTIONS IN ELECTRIC DISCHARGES. Adli S. Kana'an and John L. Margrave (Rice Univ., Houston, Tex.). Advan. Inorg. Chem. Radiochem., 6: 143-206(1964).

The available devices and special techniques being used in studies of chemical reactions in electric discharges are discussed. Topics covered include: plasma generators and the nature of electric discharge reactions, chemical reactions in glow and arc discharges, chemical reactions in plasma-jet reactors and high-intensity arcs, miscellaneous applications of electric discharge devices, and some proposed applications of plasma devices. (M.C.G.)

43458 THE CHEMISTRY OF ASTATINE. A. H. W. Aten, Jr. (Instituut voor Kernphysisch Onderzoek, Amsterdam). Advan. Inorg. Chem. Radiochem., 6: 207-23(1964).

Chemical properties of astatine are described. Production of astatine isotopes and measurement of radiation from them are reviewed. The biological behavior of astatine is also discussed. (M.C.G.)

43459 PARAMAGNETIC RESONANCE OF TRANSITION ELEMENTS AND IRRADIATED SUBSTANCES. R. C. Sahni (New York Univ., New York). Am. Soc. Testing Mater., Spec. Tech. Publ., 359(1963), 20-37(1964).

The application of electron paramagnetic resonance (EPR) spectra to well-defined systems containing unpaired electron spins such as transition metals, ions located in crystal lattice, and certain odd electron systems is discussed. Special problems such as resonance from free radicals, conduction electrons in metals and semiconductors, broken bonds, and irradiated substances are also considered. In the study of irradiated substances, discussions are centered on crystals and the dislocation and imperfections that are produced in them by radiation damage. The paramagnetic resonance study of irradiated substances is shown to give qualitative information on the nature of crystal imperfection as well as a quantitative estimate on the number of damage centers. (auth)

43460 THE THERMAL AND RADIATION OXIDATION OF BENZENE TO PHENOL IN AQUEOUS SOLUTIONS CONTAINING METAL IONS AT ELEVATED TEMPERATURES. V. THE THERMAL OXIDATION OF PHENOL AND MALEIC ACID. Kazuo Shimada, Nobutake Suzuki, Nobue Itatani, and Hiroshi Hotta (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 37: 1143-6(Aug. 1964).

The products of thermal oxidation of phenol in aqueous solutions (100 ~ 200°C) were analyzed by gas chromatography and by thin-layer chromatography. The amounts of the decomposition products, acetic acid, formic acid, acetaldehyde, formaldehyde, acetone, and carbon dioxide, increase with a rise in temperature. On the other hand, maleic acid, fumaric acid, and dihydroxybenzene decrease with a rise in temperature. Since the oxidation of maleic

acid gives acetaldehyde, formaldehyde, and acetic acid, these products are considered to be produced through maleic acid from phenol. However, acetone is not given from maleic acid, but from phenol. (auth)

43461 MEAN AMPLITUDES OF VIBRATION AND THERMODYNAMIC FUNCTIONS FOR THE TRIOXIDES OF XENON AND RHENIUM. G. Nagarajan (Oklahoma State Univ., Stillwater). Bull. Soc. Chim. Belges, 73: 665-72(July-Aug. 1964).

The mean amplitudes of vibration for the trioxides of xenon and rhenium possessing a pyramidal structure with the symmetry point group C_{3v} were evaluated on the basis of the principle postulated by Cyvin for the temperatures T = 0 and T = 298°K, respectively. The molar thermodynamic functions also were calculated for these molecules with an assumption of a rigid rotator, harmonic oscillator model for the temperature range 100–2000°K. (auth)

43462 SOME APPLICATIONS OF THE MÖSSBAUER EFFECT. P. B. Moon and D. A. O'Connor (Univ. of Birmingham, Eng.). Endeavour, 23: 131-5(Sept. 1964).

The spectral lines of gamma rays, as emitted from a nucleus, normally have some width, but R. L. Mössbauer reported that this width could be extremely small under certain conditions. The almost monoenergetic gamma rays produced by the Mössbauer effect were used in determining the mass of photons, in reducing the limits of any possible ether drift to very low levels, and in measuring the intrinsic magnetic field of crystals. This effect and its applications, both present and future, that include the simplification of crystal-structure analysis are described. (auth)

43463 REACTIONS OF MAGNESIUM OXIDE AND ZIRCONIUM DIOXIDE WITH HIGH MELTING COMPOUNDS AT HIGH VACUUM TEMPERATURES. G. V. Samsonov, A. L. Burykina, L. V. Strashinskaya, and E. A. Pugach. Izv. Akad. Nauk SSSR, Met. i Gorn. Delo, No. 4, 106-15 (July-Aug. 1964). (In Russian)

Reactions of zirconium dioxide and magnesium oxide with metal carbides (TiC, ZrC, HfC, NbC, TaC, Mo_2C, and WC), nitrides (TiN, ZrN), and borides (TiB_2, ZrB_2) in a vacuum at 1800 to 2000°C were studied. Carbide compounds proved to be the most stable in contact with MgO and ZrO_2, the boride compounds least stable. Reactions at 2200°C formed no new phases except in TaC reaction with MgO and HfC and NbC with ZrO_2. (R.V.J.)

43464 ZIRCONATES OF RARE-EARTH ELEMENTS AND THEIR PHYSICOCHEMICAL PROPERTIES. I. ZIRCONATES OF LANTHANUM, NEODYMIUM AND CERIUM. Fu-kang Fan, A. K. Kuznetsov, and E. K. Keler (Grebenshchikov Inst. of Chemistry of Silicates, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Khim., No. 7, 1151-7 (July 1964). (In Russian)

Thermal and x-ray studies showed that ZrO_2 crystallization from an amorphous state formed a metastable cubic modification which transforms into a monoclinic modification at 600°C and above. The structures of $La_2Zr_2O_7$, $Nd_2Zr_2O_7$, and $Ce_2Zr_2O_7$ were confirmed, and the mechanism of their formation from heated coprecipitated hydroxides was analyzed. Heated $Ce_2Zr_2O_7$ exhibited a tendency to oxidation and transformation into a fluorite-type cubic solid solution between CeO_2 and ZrO_2. The temperature of zirconium hydroxide reaction with rare earths is below the zirconate crystallization temperature. (R.V.J.)

43465 PHASE EQUILIBRIA IN YTTRIUM OXIDE–ALUMINA SYSTEM. N. A. Toropov, I. A. Bondar, F. Ya. Galakhov, Kh. S. Nikogosyan, and N. V. Vinogradova (Grebenshchikov Inst. of Chemistry of Silicates, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Khim., No. 7, 1158-64(July 1964). (In Russian)

A constitution diagram was constructed for $Y_2O_3-Al_2O_3$, and three metastable compounds ($2Y_2O_3 \cdot Al_2O_3$, $Y_2O_3 \cdot Al_2O_3$, and $3Y_2O_3 \cdot 5Al_2O_3$) were found. (R.V.J.)

43466 PHASE EQUILIBRIA IN $Y_2O_3-Al_2O_3-SiO_2$ SYSTEM. I. A. Bondar and F. Ya. Galakhov (Grebenshchikov Inst. of Chemistry of Silicates, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Khim., No. 7, 1325-6(July 1964). (In Russian)

The constitution diagram of $Y_2O_3-Al_2O_3-SiO_2$ was constructed, and the liquation and vitreous states were found. (R.V.J.)

43467 NEW CATALYSTS FOR THE EXCHANGE OF DEUTERIUM BETWEEN HYDROGEN GAS AND LIQUID AMMONIA. A. R. Kenyon and D. Pepper (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Appl. Chem. (London), 14: 399-405(Sept. 1964).

By experimental study of the rate of exchange of deuterium between hydrogen gas and liquid ammonia, in the presence of potassamide, it was found that certain organic amines have a catalytic effect. Use of pyrrolidine or dimethylamine with potassamide solutions could reduce the cost of heavy water produced by the ammonia–hydrogen exchange process. (auth)

43468 THERMAL DECOMPOSITION OF URANYL NITRATE HEXAHYDRATE. S. Hartland and R. J. Nesbitt (Imperial Coll. of Science and Tech., London). J. Appl. Chem. (London), 14: 406-12(Sept. 1964).

Samples of uranyl nitrate hexahydrate weighing between 3.5 and 14.7 mg were decomposed in a hot air stream flowing at 455–673 cm/sec and at temperatures between 100 and 350°C. Values of percentage weight-loss for various reaction times were obtained. The decomposition, which involved several phase changes, was also followed visually by means of a color cine film. The results between 200 and 350°C suggest that decomposition proceeds by way of two first-order reactions: $UO_2(NO_3)_2,6H_2O \xrightarrow{k_1} UO_2(NO_3)_2,H_2O + 5H_2O$ and $UO_2(NO_3)_2,H_2O \xrightarrow{k_2} UO_3 + H_2O + 2NO_2 + \frac{1}{2}O_2$ where k_1 is much greater than k_2. These results do not agree with those of others who used larger samples and lower gas flow rates and did not work in a purely chemical regime. (auth)

43469 ELECTROLYTIC REDUCTION OF TRIVALENT RARE-EARTH IONS IN ALKALINE-EARTH HALIDES. Francis K. Fong (RCA Labs., Princeton, N. J.). J. Chem. Phys., 41: 2291-6(Oct. 15, 1964).

Trivalent dysprosium, thulium, and holmium ions in calcium fluoride, strontium chloride, and barium bromide were successfully reduced to the divalent state by solid-state electrolysis. In contrast with similar samples reduced by gamma irradiation, which are unstable with respect to light and heat, the electrolytically induced divalent rare-earth ions are optically and thermally stable. Unlike the gamma-reduced samples, recombination hole centers are believed to be absent in these samples. The majority of trivalent ions were reduced, and the concentration of divalent rare-earth ions obtainable by the electrolytic process far exceeds that by gamma irradiation in all the samples, with or without charge-compensating monovalent cations. The completeness of the reduction, the stability of the reduced samples and, therefore, the apparent absence of recombination hole centers suggest that the re-

duction of the rare earth ions follows the migration of the corresponding halide ions (which, in the case of calcium fluoride, served as charge compensators for the trivalent ions) to the anode, where they are presumably oxidized to the neutral state and escape from the crystal lattice. This mechanism is not unlike that proposed for the electrolytic coloration of alkali halides. (auth)

43470 PROTON AND FLUORINE NMR SPECTRA OF HBF_2. T. C. Farrar and T. D. Coyle (National Bureau of Standards, Washington, D. C.). J. Chem. Phys., 41: 2612-13(Nov. 1, 1964).

Proton and fluorine NMR (nuclear magnetic resonance) spectra of HBF_2 were recorded in the temperature range 140 to 230°K. The values for the spin-coupling constants J_{HF}, J_{B-H}, and J_{B-F} were 108 ± 1 Hz, 211 ± 2 Hz, and 84 ± 1 Hz, respectively. J_{HF} was temperature independent. The apparent values of J_{B-H} and J_{B-F} decreased below 165°K due to the interaction of rapidly fluctuating electric field gradients with the electric quadrupole moment of boron. The center of the proton multiplet was about 0.12 ppm downfield from the center of the terminal proton multiplet in diborane. The fluorine multiplet was about 60 ppm downfield from the fluorine resonance in BF_3, which in this case was a single structureless line. The dependence of $^{11}B-H$ coupling constants on the orbital hybridization of boron is discussed. (auth)

43471 GENERALIZATION OF THE ACTIVATED COMPLEX THEORY OF REACTION RATES. I. QUANTUM MECHANICAL TREATMENT. R. A. Marcus (Polytechnic Inst. of Brooklyn and Brookhaven National Lab., Upton, N. Y.). J. Chem. Phys., 41: 2614-23(Nov. 1, 1964). (BNL-8127)

In its usual form activated complex theory assumes a quasiequilibrium between reactants and activated complex, a separable reaction coordinate, a Cartesian reaction coordinate, and an absence of interaction of rotation with internal motion in the complex. A rate expression was derived without introducing the Cartesian assumption. The expression bears a formal resemblance to the usual one and reduces to it when the added assumptions of the latter are introduced. The equation for transmission coefficient contains internal centrifugal terms. The fourth assumption can also be weakened and a rotational interaction included in the formalism. In applications of the rate equation use can be made of the finding that in the immediate vicinity of a saddle point or a minimum, a potential energy surface can be imitated in some major topographical respects by a surface permitting separation of variables. The separated wave equation for the reaction coordinate is then curvilinear because of the usual curvature of the path of steepest ascent to the saddle point. Calculations of transmission coefficients and rates can be made and compared with those obtainable from the usual one-dimensional Cartesian-like calculations on the one hand and with some based on the numerical integration of the n-dimensional Schrödinger equation on the other. An application to a common three-center problem is discussed. (auth)

43472 GENERALIZATION OF THE ACTIVATED COMPLEX THEORY OF REACTION RATES. II. CLASSICAL MECHANICAL TREATMENT. R. A. Marcus (Brookhaven National Lab., Upton, N. Y. and Polytechnic Inst. of Brooklyn). J. Chem. Phys., 41: 2624-33(Nov. 1, 1964). (BNL-8205)

In its usual classical form, activated-complex theory assumes a particular expression for the kinetic energy of the reacting system, one associated with a rectilinear motion along the reaction coordinate. The derivation of the rate expression given is based on the general kinetic-energy expression. A rate equation of the customary form is obtained: $k_{rate} = (kT/h)\exp[-F^{\ddagger} - F^{r})/kT]$, where $F^{\ddagger}$ is the free energy of a system constrained to exist on a hypersurface in n-dimensional space and F^{r} is the free energy of the reactants. The usual derivation is then reinterpreted, in terms of geodesic normal coordinates, to be somewhat more general than it appears. Normally, rotation-vibration interaction is neglected, as in the above derivation, although not in treatments of some special reactions in the literature for which the centrifugal potential is important. A derivation is given that includes the influence of this centrifugal potential but omits Coriolis effects. (auth)

43473 RELAXATION OF A LORENTZ GAS WITH A REPULSIVE r^{-s} FORCE LAW. Hansjoerg Oser, Kurt E. Shuler, and George H. Weiss (National Bureau of Standards, Washington, D. C.). J. Chem. Phys., 41: 2661-6 (Nov. 1, 1964).

The relaxation of a Lorentz gas (dilute light particle subsystem in a heavy particle heat bath) was studied for a repulsive r^{-s} central force law interaction between the light and heavy particles. The Fokker-Planck equation for the velocity distribution functions of the light particle subsystem was solved numerically for s = 5, 9, 13, 21, and ∞ for various initial conditions. The dependence of the rate of relaxation and of the form of the time-dependent velocity distribution function on the force law parameter s is discussed in light of these results. (auth)

43474 SELENIUM ISOTOPE EFFECTS IN FLUORINE NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY. T. Birchall, S. L. Crossley, and R. J. Gillespie (McMaster Univ., Hamilton, Ont.). J. Chem. Phys., 41: 2760-1(Nov. 1, 1964).

A selenium isotope effect on the fluorine chemical shift was observed in several selenium–fluorine compounds for all of the naturally occurring selenium isotopes except ^{74}Se. Values for some $^{77}Se-^{19}F$ coupling constants are reported. (auth)

43475 ANHARMONIC FORCES AND THE VAPOR-PRESSURE RATIO OF MONATOMIC ISOTOPIC SOLIDS. [PART] II. M. L. Klein (Univ. of Bristol, Eng.) and J. A. Reissland. J. Chem. Phys., 41: 2773-6(Nov. 1, 1964).

The anharmonic contribution to the vapor-pressure ratio of ^{36}Ar and ^{40}Ar was calculated using a Mie-Lennard-Jones 6, n potential with n = 10 and 12. The contribution of the vibrational anharmonicity was found to be large and tended to cancel the effect of thermal expansion. Numerical calculations for the 6, 10 potential were found to agree well with experimental measurements of the isotope separation factor. A brief discussion is given of vapor pressure ratio data for ^{20}Ne and ^{22}Ne. (auth)

43476 MASS-SPECTROMETRIC INVESTIGATION OF THE YTTRIUM–CHLORINE SURFACE REACTION. John D. McKinley (National Bureau of Standards, Washington, D. C.). J. Chem. Phys., 41: 2814-17(Nov. 1, 1964).

Volatile products of the surface reaction between chlorine at room temperature and heated polycrystalline yttrium were identified and their formation rates were measured mass spectrometrically. At surface temperatures between 300 and 1700°K (yttrium melting point 1750°K) and chlorine pressures between 10^{-5} and 5×10^{-4} torr, Cl, YCl_2 and CL_2 were observed. No gaseous YCl or YCL_2 was detected. The results were consistent with the presence of

a strongly chemisorbed layer of chlorine atoms, stable over the entire temperature range, on which Cl_2 adsorbs as Cl atoms. These either evaporated or reacted with YCl to form volatile YCl_2. An activation energy of 55 kcal/mole for YCl_2 evaporation was apparently associated with dissociative adsorption of chlorine on the chemisorbed Cl layer. (auth)

43477 VAPOR PRESSURES OF THE RARE-EARTH METALS. C. E. Habermann and A. H. Daane (Iowa State Univ., Ames). J. Chem. Phys., 41: 2818-27(Nov. 1, 1964). (IS-789)

Vapor-pressure measurements on rare earth metals were made by the Knudsen effusion technique using a quartz-fiber microbalance over a pressure range of 10^{-1} to 10^{-4} mm of Hg. The material used was specially prepared in order to minimize impurity effects. Ytterbium was the most volatile of the rare earths, while lanthanum and cerium were the least volatile. The data were fitted to a straight line by the least-squares method and the heats of vaporization or sublimation were calculated from the slope of the line. The heats of sublimation at 298°K were then calculated using the best available data for the enthalpies of the condensed and vapor states. For nine of the elements, measured heat content and entropy data for the condensed state as well as calculated free energy functions for the gaseous state were available, permitting a third law calculation of $\Delta H_{298}°$. The second- and third-law methods were generally in good agreement, but a comparison of this work and previous investigations revealed several differences, amounting to as much as 15 kcal/mole in the case of gadolinium. A possible explanation for the variations in the room temperature heats of sublimation of the different rare earths, based on the differences in the electronic structures of the gaseous atoms and the number of d electrons present in the condensed phase, is presented. (auth)

43478 KINETIC STUDIES OF HYDROXYL RADICALS IN SHOCK WAVES. IV. RECOMBINATION RATES IN RICH HYDROGEN–OXYGEN MIXTURES. Garry L. Schott and Paul F. Bird (Los Alamos Scientific Lab., N. Mex.). J. Chem. Phys., 41: 2869-76(Nov. 1, 1964). (LADC-6123)

The rate of disappearance of OH following $[OH]_{max}$ in shocked H_2-O_2-Ar mixtures was measured by a refined ultraviolet line absorption technique. Thirty-one experiments were carried out with mixtures of 4% H_2, 1% O_2, 95% Ar; 2% H_2, 0.5% O_2, 97.5% Ar; and 8% H_2, 1% O_2, 91% Ar at initial pressures between 50 and 200 mm Hg. The approximate rate equation found to describe the OH disappearance is $-d[OH]/dt = k_{apparent}[OH]^2[M]$, where [M] is total gas concentration. Assuming that the equilibrium relationship $\alpha = [OH]/[H] = K[H_2O]/[H_2]$ is maintained, and that the recombination reactions are: $H + H + M \xrightarrow{k_1} H_2 + M$, and $H + OH + M \xrightarrow{k_2} H_2O + M$, $k_{apparent}$ may be interpreted as $(A/\alpha)(k_1 + \alpha k_2)$ where A is a factor near unity that incorporates the definitions of the k's as volumetric rate coefficients, the small variation of α and density during the reaction, and the participation of O and O_2. The value of $(k_1 + \alpha k_2)$ increased linearly with α between $\alpha = 0.01$ and $\alpha = 0.1$, yielding $k_1 = 6 \pm 1 \times 10^8$ liter^2 mole^{-2} · sec^{-1} and $k_2/k_1 \approx 10 \pm 5$. No dependence on temperature was evident. Estimation of the contributions of H_2, H, and H_2O as third bodies indicated that $k_1^{Ar} = 4 \pm 2 \times 10^8$ liter^2 mole^{-2} · sec^{-1} near 1700°K. (auth)

43479 SEPARATION OF INORGANIC IONS IN FUSED SALTS BY MEANS OF CHROMATOGRAPHY AND ELECTROPHORESIS ON GLASS FIBER PAPER. III. EFFECT OF WATER, OXYGEN AND SUPPORT ON THE MIGRATION OF INORGANIC IONS DISSOLVED IN THE LiCl–KCl EUTECTIC AT 450°. G. Alberti, S. Allulli, and G. Modugno (C.N.E.N., Rome; C.N.R., Rome; and Università, Rome). J. Chromatog., 15: 420-7(Aug. 1964).

The chromatographic and electrophoretic behavior of different metal ions dissolved in LiCl–KCl eutectic was studied. Traces of water in the eutectic precipitate metal ions forming sparingly soluble oxides in fused alkali chlorides. The ions examined did not react with the glass fiber paper employed as support. When the ions to be examined are easily oxidized or give sparingly soluble oxides in molten chlorides the experiments must be performed in an inert gas atmosphere (water- and oxygen-free). The chromatographic and electrophoretic behavior of some inorganic ions is reported and the electroendosmotic effect in fused chlorides, employing glass fiber paper as support, is discussed. (auth)

43480 PREPARATION AND PROPERTIES OF A NEW MONOHYDRATE OF URANIUM TRIOXIDE ϵ-$UO_3 \cdot H_2O$. E. H. P. Cordfunke and P. C. Debets (Reactor Centrum Nederland, Petten, Netherlands). J. Inorg. Nucl. Chem., 26: 1671-7(Oct. 1964).

The preparation of a monohydrate of uranium trioxide, ϵ-$UO_3 \cdot H_2O$, is described. Its relationship with the other monohydrates of UO_3 is discussed. The x-ray powder diagram of ϵ-$UO_3 \cdot H_2O$ could be indexed by means of a monoclinic, side-centered cell, with: a = 6.419, b = 5.561, and c = 5.518 Å, and $\beta = 112°46'$. (auth)

43481 SYNTHESIS OF URANIUM MONOPHOSPHIDE BY THE PHOSPHINE REACTION. Y. Baskin and P. D. Shalek (Argonne National Lab., Ill.). J. Inorg. Nucl. Chem., 26: 1679-84(Oct. 1964).

A method is described for synthesizing uranium monophosphide by reacting finely divided uranium with phosphine gas (PH_3). Reaction temperatures and phosphorus to uranium ratios were varied over a relatively wide range. Best overall results were obtained when the reaction was carried out at 385°C using a phosphorus to uranium ratio of slightly greater than one. Calcination of the reacted material in vacuum at 1400°C resulted in its homogenization and elimination of excess phosphorus to form uranium monophosphide. Chemical, x-ray diffraction, particle size, and other property data are presented for the various UP powders. (auth)

43482 A STUDY OF URANYL PHOSPHATES. I. SORPTION PROPERTIES OF URANYL HYDROGEN PHOSPHATE. V. Pekárek and M. Benešová (Inst. of Nuclear Research, Řež, Czechoslovakia). J. Inorg. Nucl. Chem., 26: 1743-51 (Oct. 1964).

The synthesis, analysis, and properties of uranyl hydrogen phosphate are described; the sorption of some 1- to 4-valent cations and the separation of alkali cations were studied. Qualitative conclusions were deduced for the sorption mechanism, and selectivity coefficients for the pairs of ions $Cs^+-NH_4^+$, Cs^+-Na^+, Cs^+-K^+, and Cs^+-Rb^+ were determined. (auth)

43483 NITRATO-COORDINATION OF THE URANYL ION. W. R. Walker (Duquesne Univ., Pittsburgh). J. Inorg. Nucl. Chem., 26: 1753-5(Oct. 1964).

An attempt was made to prepare $UO_2(NO_3)_2 \cdot 2TBP$ by heating $UO_2(DMF)_2(NO_3)_2$, where DMF is dimethylformamide, in TBP. The compound $[UO_2(DMF)_3](ClO_4)_2$ was also prepared for investigation and to see whether the proposal of Edwards and Stritar (Science, 142: 1651(1963))

that the uranyl ion coordinates to five monodentate oxygen ligands is tenable. It was concluded that there is no perchlorato-coordination, but that nitrato groups are coordinated to the uranyl ion. (M.C.G.)

43484 A STUDY OF CATECHOL DERIVATIVES OF BERYLLIUM. S. N. Dubey and R. C. Mehrotra (Univ. of Rajasthan, Jaipur, India). J. Less-Common Metals, 7: 169-75(Sept. 1964).

A detailed study of the beryllium–catechol system was carried out by potentiometric and conductometric methods and the correctness of the assumed formation of 1:1 and 1:2 complexes in the system was confirmed by preparative studies. The formation constants of these derivatives were determined by the Bjerrum and Calvin method. (auth)

43485 STATISTICAL THERMODYNAMICS OF THE POLYPHENYLS. I. MOLAR VOLUMES AND COMPRESSIBILITIES OF BIPHENYL AND m-, o-, AND p-TERPHENYL SOLID AND LIQUID. Jack Opdycke, James P. Dawson, Ronald K. Clark, Melvyn Dutton, James J. Ewing, and Hartland H. Schmidt (Univ. of California, Riverside). J. Phys. Chem., 68: 2385-92(Sept. 1964).

The molar volumes and isothermal compressibilities of biphenyl and of o-, m-, and p-terphenyl were measured in the solid and liquid ranges from room temperature up to 350, 450, 400, and 400°C, respectively, and up to 170 atm pressure. Individual liquid isotherms were fitted by a quadratic expression in the pressure to within the precision limits of the volume measurements which range from $\pm 10^{-5}$ to $\pm 10^{-4}$ l/mole probable error. Coefficients of the isotherm expressions were expanded in a power series in temperature to provide a single empirical expression for the volume of each compound over the whole liquid range. Representative values of the molar volumes (l/mole) at zero pressure are: biphenyl, 0.13153 (s, 30°) and 0.15573 (l, 75°); o-terphenyl, 0.19775 (s, 30°) and 0.22180 (l, 75°); m-terphenyl, 0.19234 (s, 30°), and 0.22279 (l, 100°); p-terphenyl, 0.18836 (s, 30°) and 0.24298 (l, 225°). The results were compared with the predictions of the Tait equation for the compressibility of liquids and the function $TV^2(\partial P/\partial T)_v = a$ was compared for the compounds. The Tait equation constant C is roughly independent of temperature within the first 100°C above the melting point but increased somewhat at higher temperatures. The function a was found to increase with pressure over most of the temperature range and has a total maximum variation of 20% for any one compound over the liquid range investigated. (auth)

43486 STATISTICAL THERMODYNAMICS OF THE POLYPHENYLS. II. FREE VOLUME AND CORRESPONDING STATES TREATMENTS OF LIQUID BIPHENYL AND m-, o-, AND p-TERPHENYL. Hartland H. Schmidt, Jack Opdycke, and Ronald K. Clark (Univ. of California, Riverside). J. Phys. Chem., 68: 2393-8(Sept. 1964).

Liquid volume and compressibility data on biphenyl and the three terphenyls were used as an example for the application of statistical thermodynamic theories of liquid polymers including the effects of restricted internal flexibility. The free volume model of Eyring and Hirschfelder as recently adapted to polymers by Flory and the corresponding states treatment of Prigogine and co-workers both lead to essentially the same correlations of the ratios of the intermolecular intersegment minimum potential energy, ϵ^*, and distance, r^*, parameters among the polyphenyls although the former model is more detailed in giving a specific form for the equation of state and for the relationship of the molecular parameters to the liquid PVT data. The corresponding states theory yields values of r^* for biphenyl and o-, m-, and p-terphenyl 0.9708, 0.9619, 0.9592, and 0.9571 times that of benzene, respectively, as evaluated from the molar volume data. The ϵ^* values, which are derived from the compressibility data, and the assumption of a rigid rotor model to account for the polymer external degrees of freedom are 1.26, 1.23, and 1.23 times that of benzene for biphenyl and o- and m-terphenyl, respectively. The value of ϵ^* and the compressibility data for p-terphenyl are consistent with these quantities for the other compounds, according to the corresponding states treatment used, only if the number of external degrees of freedom is adjusted from the five expected for a rigid linear rotor to about six. The less specific corresponding states treatment of others allows a somewhat better correlation of the data than does the free volume model with constant ϵ^* and r^*. (auth)

43487 THE REACTION OF HYDROGEN WITH CERIUM METAL AT 25°. K. H. Gayer and W. G. Bos (Wayne State Univ., Detroit). J. Phys. Chem., 68: 2569-74(Sept. 1964).

The rate of absorption of hydrogen by plates of cerium metal was studied at 25.0°C and pressures from 100 to 600 mm. For a given constant pressure, the plot of hydrogen absorbed as a function of time was sigmoidal. Corresponding to the different segments of the absorption curves were the four reaction stages: induction, autoacceleration, linear, and deceleration. The reaction rate was found to be sensitive to gaseous impurities and to the thermal pretreatment of the metal samples. For the linear stage of the reaction, the pressure dependence of the rate could be described with reasonable accuracy by the equation $r = k_1p + k_2$, where r is the rate in ml (STP)/cm^2 of original surface, $k_1 = 5.0 \times 10^{-4}$ ml/cm^2 mm^{-1}, and k_2 varies from sample to sample. Some aspects of the reaction are discussed. (auth)

43488 SUBSTITUENT EFFECTS ON ACIDITIES IN WATER AND DEUTERIUM OXIDE. Loren G. Hepler (Australian Commonwealth Scientific and Industrial Research Organization, Melbourne and Univ. of New England, Armidale, Australia). J. Phys. Chem., 68: 2645-8(Sept. 1964).

Substituent effects on acidities in H_2O and D_2O were considered in terms of reactions $HA + R^- \overset{H_2O}{=} A^- + HR$ and $DA + R^- \overset{D_2O}{=} A^- + DR$ in which HR and DR represent reference acids. Evidence is presented that internal energy effects (ΔH_{int} and $\Delta H'_{int}$ for H- and D-containing systems, respectively) are the important contributors to ΔG^0 for the reactions above, leading to the equation $(pK_{DA} - pK_{DR})/(pK_{HA} - pK_{HR}) = \Delta H'_{int}/\Delta H_{int}$. Consideration of ΔH_{int} and $\Delta H'_{int}$ in terms of potential curves and vibrational frequencies led to the conclusion that substituent effects are expected to be larger for D acids in D_2O than for H acids in H_2O, and that the ratio of substituent effects is generally largest when the substituent effects are small. The model and equations are discussed in relation to the widely used equation $pK_{DA} - pK_{HA} = a + bpK_{HA}$. (auth)

43489 ELECTRONIC STATES OF POSITIVE IONS. Kenji Fueki (Univ. of Notre Dame, Ind.). J. Phys. Chem., 68: 2656-60(Sept. 1964).

The ionization potentials of saturated hydrocarbons and the bond dissociation energies of their ions were calculated by the extended method of equivalent orbitals. The matrix elements were estimated in a semiempirical way. The same method was applied to the calculation of the ionization potentials of alkyl halides. The calculated results are generally in agreement with experiment. (auth)

43490 THE THERMODYNAMIC AND PHYSICAL PROPERTIES OF BERYLLIUM COMPOUNDS. VI. THE HEAT OF FORMATION OF BERYLLIUM NITRIDE. Robert E. Yates, Michael A. Greenbaum, and Milton Farber (Rocket Power, Inc., Pasadena, Calif.). J. Phys. Chem., 68: 2682-6(Sept. 1964).

The decomposition pressures of solid Be_3N_2 to Be(g) and N_2(g) over the temperature range 1450–1650°K were determined by the torsion effusion technique. From the data obtained in this research and available thermodynamic properties of the species involved, a third-law value of $\Delta H_{f,298}$ for Be_3N_2(s) was found to be −140.3 ± 1.5 kcal/mole. (auth)

43491 THE HEAT OF FORMATION OF EUROPIUM SESQUIOXIDE. Elmer J. Huber, Jr., George C. Fitzgibbon, and Charles E. Holley, Jr. (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem., 68: 2720-2(Sept. 1964). (LADC-6317)

Oxygen bomb experiments were used to determine the heat of combustion of europium metal. In addition, heat-of-solution measurements were made on the monoclinic and cubic forms of the sesquioxide. Weighing the combustion values inversely proportional to the square of their uncertainties, combining them, and converting to ΔH^0_{298} yielded a value of −393.9 ± 0.9 kcal/mole for the heat of formation of monoclinic (B-type) Eu_2O_3. The heat of formation of cubic (C-type) Eu_2O_3 was calculated from the heats of solution of the cubic and monoclinic forms of Eu_2O_3 to be −389.6 ± 1.1 kcal/mole. (P.C.H.)

43492 BORON ISOTOPE EXCHANGE BETWEEN BORON FLUORIDE AND ITS ALKYL HALIDE COMPLEXES. I. RELATION BETWEEN EQUILIBRIUM CONSTANT OF ISOTOPIC EXCHANGE REACTION, STABILITY, AND CATALYTIC ACTIVITY OF BORON FLUORIDE COMPLEX. Ryohie Nakane, Osamu Kurihara, and Akiko Natsubori (Inst. of Physical and Chemical Research, Tokyo). J. Phys. Chem., 68: 2876-82(Oct. 1964).

Equilibrium constants of boron isotope exchange between boron fluoride gas on one side and boron fluoride–t-butyl chloride, -isopropyl chloride, and -methyl fluoride complexes on the other were found to be 1.033, 1.021, and 1.026 at −112°. Toluene was found to be readily alkylated with t-butyl chloride as well as alkyl fluoride in the presence of boron fluoride. Moreover, it is suggested that if the equilibrium constant becomes large, the polarity of the complex will increase; hence, the stability and catalytic activity of the complex will become high. This leads to the following conclusion: boron fluoride–t-butyl chloride, -methyl fluoride, -methyl chloride, and -isopropyl chloride complexes are polar complexes, and the polarity of these complexes decreases in the order:

$\overset{\delta-}{B}F_3 \leftarrow \overset{\delta+}{C}lC(CH_3)_3 > \overset{\delta-}{B}F_3 \leftarrow \overset{\delta+}{F}CH_3 > \overset{\delta-}{B}F_3 \leftarrow \overset{\delta+}{C}lCH(CH_3)_2$,

$\overset{\delta-}{B}F_3 \leftarrow Cl\overset{\delta+}{C}H_3$. The aromatic constituent reacts with boron fluoride–t-butyl chloride complex by a nucleophilic displacement reaction. (auth)

43493 THE HEATS OF FORMATION OF ZIRCONIUM DIBORIDE AND DIOXIDE. Elmer J. Huber, Jr., Earl L. Head, and Charles E. Holley, Jr. (Los Alamos Scientific Lab., N. Mex.). J. Phys. Chem., 68: 3040-2(Oct. 1964). (LADC-6462)

The heat of formation of zirconium diboride as determined by oxygen bomb calorimetry on two samples of the material was $\Delta H^0_{f298} = -77.2 \pm 1.2$ kcal/mole. The heat of formation of zirconium dioxide from the combustion of the metal in oxygen was $\Delta H^0_{f298} = -263.1 \pm 0.5$ kcal/mole. (auth)

43494 ELECTROMOTIVE FORCE STUDIES IN AQUEOUS SOLUTIONS AT ELEVATED TEMPERATURES. V. THE THERMODYNAMIC PROPERTIES OF DCl SOLUTIONS. M. H. Lietzke and R. W. Stoughton (Oak Ridge National Lab., Tenn.). J. Phys. Chem., 68: 3043-8(Oct. 1964). (ORNL-P-57)

Measurements of the emf of the cell, Pt–D_2(p)|DCl(m)|AgCl, Ag, were used to determine the thermodynamic properties of DCl solutions in D_2O as well as the standard potential of the cell to 225°C. The standard potential was found to be lower in the deuterated system than in the corresponding protonated system and as the difference became greater the higher the temperature. Activity coefficient behavior in the two systems is consistent with a lower value of the dielectric constant of D_2O at all temperatures. As judged from the variation of activity coefficients with temperatures and concentration the difference in the dielectric constant values appears to go through a minimum at about 100°C. (auth)

43495 KINETICS OF ISOTOPE EXCHANGE IN A MOLECULAR OXYGEN—SOLID OXIDE SYSTEM. V. S. Muzykantov, V. V. Popovskii, and G. R. Boreskov (Inst. of Catalysis, Academy of Sciences, Siberian SSR). Kinetika i Kataliz, 4: 624-9(July-Aug. 1964). (In Russian)

Kinetics of isotopic exchange in a molecular oxygen-solid oxide system with simultaneous monomolecular and isotopic exchange were studied. The kinetics offer some explanations of the oxide exchange mechanism. (tr-auth)

43496 MECHANISM OF ISOTOPIC EXCHANGE OF OXYGEN WITH VANADIUM PENTOXIDE. V. S. Muzykantov, V. V. Popovskii, G. K. Boreskov, and N. I. Mikichur (Inst. of Catalysis, Academy of Sciences, Siberian SSR). Kinetika i Kataliz, 4: 745-8(July-Aug. 1964). (In Russian)

An analysis was made to determine which of the three exchange mechanisms (replacement of an atom in the molecule by an oxygen atom of the solid, replacement of two atoms, or molecular exchange without direct participation of oxide oxygen) took place in oxygen exchange with vanadium pentoxide. The analysis indicated high oxygen mobility in the oxide. At 450 to 500°C lattice diffusion did not limit the rate of exchange, and the isotopic composition of the oxide remained homogeneous along the solid phase. The tabulated results show that isotopic exchange between molecular oxygen and vanadium pentoxide follows a two-atom replacement mechanism. (R.V.J.)

43497 ^{14}N CHEMICAL SHIFTS IN ORGANIC COMPOUNDS. D. Herbison-Evans and R. E. Richards (Physical Chemistry Lab., Oxford). Mol. Phys., 8: 19-31(1964).

Quadrupole broadening of nitrogen nuclear resonances can be minimized by using solvents of low viscosity. An extensive survey is presented of ^{14}N chemical shifts in organic compounds. (auth)

43498 STUDIES ON THE BEHAVIOR OF SEVERAL ELEMENTS IN THE FUSED BISMUTH–FUSED SALTS SYSTEM. III. DISTRIBUTION OF POLONIUM BETWEEN FUSED BISMUTH AND FUSED LiCl–KCl (EUTECTIC). Yuichiro Kamemoto and Shigeru Yamagishi (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 6: 500-3(Sept. 1964). (In Japanese)

The distribution of polonium between fused bismuth and fused LiCl · KCl (eutectic) was investigated at 550°C in argon atmosphere. Twenty grams of pure salt were added to 20 g of the fused bismuth containing a trace amount of polonium. After the salt was contacted with bismuth for 3 ~ 7 hr at 550°C, a small amount of each layer was sampled and partition coefficient of polonium [K = concentration in salt (cpm/g)/concentration in bismuth (cpm/g)] was deter-

mined. K value of polonium was 0.098. The effect of temperature on the K value was not observed for 400 ~ 565°C. About 97% of the polonium was removed from bismuth layer at 350 ~ 530°C for 3 hr. This result suggested that the distillation of polonium with fused salt is useful as the separation method of polonium from bismuth. (auth)

43499 PROTON MOTION IN SOME HYDROGENOUS LIQUIDS STUDIED BY COLD NEUTRON SCATTERING. K.-E. Larsson and U. Dahlborg (Royal Inst. of Tech., Stockholm and Aktiebolaget Atomenergi, Stockholm). Physica, 30: 1561-99(Aug. 1964).

Using the cold neutron time-of-flight spectrometer a series of hydrogenous liquids were investigated. The diffusive motions in the liquids as well as their spectra of hindered translations and rotations are investigated in great detail. It is found that the neutron is very sensitive to the rate determining process of the proton motion. Relaxation times for various motions of the protons in and between the molecules are determined. It is found that the mean life time of a hydrogen bond is in the range 10^{-11} to 10^{-12} seconds for the liquids investigated. Similarly the activation energy for the motion of the protons is determined in various temperature regions. It is shown that the diffusion process may be described as a simple random walk process after a time of about 10^{-12} seconds has elapsed. Comparison of the experimental results to various theories for neutron scattering from liquids is performed. The results of the relaxation time studies are compared to experimental results of dielectric ultrasonic and nuclear magnetic relaxation time studies. It is shown that very probably a cluster formation of molecules occurs and the size of these clusters as a function of temperature is indicated. (auth)

43500 DEUTERIUM OXIDE SOLVENT EFFECTS ON ULTRAVIOLET ABSORPTION OF ANIONS. M. Halmann and I. Platzner (Weizmann Inst. of Science, Rehovoth, Israel). Proc. Chem. Soc., 261-2(Aug. 1964).

The uv absorption spectra of anions in water and water-d_2 were compared. For halide ions, the lowest-energy bands of which were found to be due to charge-transfer-to-solvent (CTTS) transitions, blue-shifts of 400 cm^{-1} or 1.1 kcal $mole^{-1}$ were observed in passing from H_2O to D_2O, while the intramolecular transitions of nitrate or nitrite ions were not appreciably affected. For orthophosphate anions, the D_2O effects support other evidence in assigning the weak low-energy bands to intramolecular transitions, and the steep high-energy absorption edge to a CTTS transition. Considerable blue-shifts of spectra in D_2O (400 to 800 cm^{-1}) seem to be diagnostic of CTTS transitions, while lack of effect or slight red-shifts seem to indicate intramolecular transitions. Data are tabulated. (P.C.H.)

43501 SECONDARY DEUTERIUM ISOTOPE EFFECTS IN SOLVOLYSES OF SMALL-RING COMPOUNDS. Marija Nikoletić, Stanko Borčić, and Dionis E. Sunko (Institut "Rudjer Bošković," Zagreb). Proc. Natl. Acad. Sci. U. S., 52: 893-6(Oct. 1964).

Cyclopropylcarbinyl compounds were prepared and secondary deuterium isotope effects on their ethanolysis rates were measured. It was found that methyl substitution on the ring produced a considerably larger rate effect than the corresponding phenyl substitution. In some cases the secondary deuterium kinetic isotope effect was negligible; this appeared to correspond to the pronounced lack of phenyl substitution effects on the reaction rates. (M.C.G.)

43502 THE GROUND STATES OF SCANDIUM AND YTTRIUM MONOFLUORIDES. R. F. Barrow and W. J. M. Gissane (Oxford Univ.). Proc. Phys. Soc. (London), 84: 615-16(Oct. 1964).

Rotational analysis shows that triplet bands of ScF observed in absorption arise from a transition $^3\Phi_r - {}^3\Delta_r$. Since singlet systems with a common lower state x $^1\Sigma^+$ also appear in absorption, the two states $\sigma^2\ ^1\Sigma^+$ and $\sigma\delta\ ^3\Delta$ lie close together; and it is uncertain which is the lower state. In the case of YF, singlet systems only have been observed so far. Bands of two $^1\Pi - x\ ^1\Sigma^+$ systems were analyzed; $\sigma^2\ ^1\Sigma^+$ is very probably the lowest state of YF. (auth)

43503 CATION SELF EXCHANGE IN THIN LAYERS OF SULFONATED POLYSTYRENES. W. Knoch and R. Lindner (Technische Hochschule, Brunswick). Radiochim. Acta, 2: 161-2(Mar. 1964). (In German)

A simple method for the determination of the exchange velocity of cations using sulfonated polystyrene films is described. The self-exchange of Ca and Y is dependent on the concentration of the aqueous solution, the thickness of the adhering liquid film, and the thickness of the sulfonated layer. Film diffusion, diffusion in the exchange layer, and chemical reactions are the time-determining stages of the ion exchange. (J.S.R.)

43504 RADIOCHEMICAL MEASUREMENT OF HETEROGENEOUS EXCHANGE OF ISOTOPIC AND NON-ISOTOPIC IONS ON THE SURFACE OF ALKALINE EARTH CARBONATES. K. H. Lieser (Technische Hochschule, Darmstadt, Ger.). Radiochim. Acta, 3: 93-9(Oct. 1964). (In German)

Solutions labeled by ^{45}Ca, ^{89}Sr, or ^{140}Ba were used to examine the ion exchange on the surface of alkaline earth carbonates as a function of time and with CO_2 excluded. From the results the equilibrium constants for the exchange between solution and surface were calculated and compared. The half life times found for the recrystallization are discussed. (auth)

43505 SODIUM PERXENATE AND XENON(II) DIFLUORIDE REDUCTION AT THE DROPPING-MERCURY ELECTRODE. Bruno Jaselskis (Loyola Univ., Chicago). Science, 146: 263-4(Oct. 9, 1964).

Sodium perxenate in alkaline solutions was reduced in a single step to xenon at the dropping-mercury electrode. The half-wave potential for perxenate changes from −0.21 to −0.31 volts against a Hg_2SO_4−Hg reference electrode in the pH range 10.1 to 11.3. Xenon(II) difluoride in acidic solutions was reduced in a single step to xenon at the potential of approximately zero against the Hg_2SO_4−Hg reference electrode. The reduction wave was followed by a broad maximum that can be effectively suppressed by fluoride ion. The diffusion current varies in linear fashion with concentration. (auth)

43506 THE ABSORPTION SPECTRUM OF PLUTONIUM HEXAFLUORIDE. Martin J. Steindler and William H Gunther (Argonne National Lab., Ill.). Spectrochim. Acta, 20: 1319-22(Aug. 1964).

The spectrum of plutonium hexafluoride was recorded in the region of 2000 to 22000 Å and the principal peaks together with their molar absorptivities were tabulated. Bands in the near infrared (4000 to 14000 Å) showed appreciable fine structure. The peak separations were correlated with molecular vibration frequencies. (M.C.G.)

43507 SPECTROSCOPIC STUDIES OF LEWIS ACID-BASE COMPLEXES. I. VIBRATIONAL SPECTRA AND ASSIGNMENTS FOR TRIMETHYLYMINE COMPLEXES

OF BORON HALIDES. Robert L. Amster and Robert C. Taylor (Univ. of Michigan, Ann Arbor). Spectrochim. Acta, 20: 1487-1502(Oct. 1964).

Infrared and Raman spectra of 1:1 complexes of trimethylamine with boron trifluoride, boron trichloride, and boron tribromide were obtained in the solid state. Samples studied included those isotopically enriched in ^{10}B as well as those containing the natural isotopic ratio of ^{11}B to ^{10}B. On the basis of isotopic shifts and trends of frequencies within the series, vibrational assignments of the observed frequencies are proposed. (auth)

43508 ELECTRONIC ABSORPTION SPECTRA OF URANIUM(IV) CHLORIDES IN SOME ORGANIC SOLVENTS AND FUSED CHLORIDES. S. Gutniak and M. Taube (Inst. of Nuclear Research, Warsaw). Spectrochim. Acta, 20: 1627-32(Oct. 1964).

The visible absorption spectra of uranium(IV) in hydrochloric acid aqueous solutions, in organic solvents, and in fused chlorides were determined and the electronic transitions $^3H_4-^3P_2$, $^3H_4-^1I_6$, $^3H_4-^3P_1$, and $^3H_4-^1D_2$ or $^3H_4-^1G_4$ with 5f shell, were identified. The ligand's field influence on these uranium(IV) complexes by means of multiplets splitting parameter ζ and the shift of absorption bands was examined. (auth)

43509 INVESTIGATIONS OF URANYL TUNGSTATES AND MOLYBDATES. V. K. Trunov and L. M. Kovba. Vestn. Mosk. Univ., Ser. II, Khim., No. 6, 34-5(Nov.-Dec. 1963). (In Russian)

Synthesis of uranyl tungstates and molybdates was achieved by prolonged (50 hr) boiling of aqueous suspensions of uranyl hydroxide, molybdenum anhydride, and tungstic acid. X-ray phase analysis indicated that $UO_2MoO_4 \cdot 4H_2O$, $UO_2Mo_2O_7 \cdot 3.5H_2O$, and $UO_2W_2O_7 \cdot 4H_2O$ are individual compounds. The magnitudes of interplanar spacing in uranyl molybdates and tungstates are tabulated. (R.V.J.)

43510 OBTAINING ISOTOPE TARGETS OF IRON AND CHROMIUM FOR NUCLEAR INVESTIGATIONS. V. N. Medyanik, V. N. Karev, and A. P. Klyucharev (Inst. of Physics and Tech., Khar'kov). Ukr. Fiz. Zh., 9: 798-9 (July 1964). (In Ukrainian)

Descriptions are given of an electrolytic method for preparing isotopic iron and chromium target foils. Thermal treatment of the precipitants produced less than 1-μ foils which could be stored for unlimited periods. X-ray analysis indicated complete absence of copper in the foils. (R.V.J.)

43511 THEORETICAL ASPECTS OF SOME THERMODYNAMIC ISOTOPE EFFECTS. Anatol Selecki and Zbigniew Dobkowski. Wiadomosci Chem., 18: 523-33 (Sept. 1964). (In Polish)

Bigeleisen's method of thermodynamic isotope effects calculation is discussed, including isotope effects in condensed systems. (auth)

43512 PARAMAGNETIC RELAXATION IN HOLMIUM AND DYSPROSIUM ETHYL SULFATE. Heinz Kalbfleisch (Technische Hochschule, Karlsruhe, Ger.). Z. Physik, 181: 13-21(1964). (In German)

The magneto-optical Faraday effect was used to measure the spin-lattice relaxation time T_1 of the rare earth ions Ho and Dy in the ethyl sulfate in the temperature range $1.4 \leq T \leq 2.15°K$ and for magnetic fields between 100 and 5300 oersteds. The magnetic field was pulse modulated and the approach to equilibrium in the spin populations was studied. The measured dependence of T_1 on the temperature is in good agreement with theory. Cross-relaxation processes were identified in the holmium ethyl sulfate. (auth)

43513 THEORY OF MULTIPOLE RELAXATION. H. Schwegler (Technische Hochschule, Darmstadt, Ger.). Z. Physik, 181: 22-43(1964). (In German)

The multipole resonance and relaxation is discussed starting with a general consideration of the quantum mechanical dynamics of spin systems with arbitrary spin I. The irreversible entropy production as a function of the multipolarizations is calculated from the density operator, expanded in terms of a complete set of orthonormal multipole operators. By use of the methods of thermodynamics of irreversible processes one obtains relaxation equations, which are a generalization of the Bloch equations of pure magnetic dipole relaxation. They connect the time derivatives of the multipolarizations with affinities, which are defined by the expansion of the logarithms of the density operator; for small multipolarizations the affinities are equal to the multipolarizations themselves. Relations for the relaxation matrix are discussed, especially a derivation is given for reciprocal relations between the relaxation coefficients. In the special case of spin I = 1 the equations of quadrupole relaxation are studied for axial symmetry. (auth)

43514 EPR STUDY OF THE ANNIHILATION OF ION RADICALS IN IONIC CRYSTALS. A. G. Kotov and S. Ya. Pshezhetskii. Zh. Fiz. Khim., 38: 1926-30(Aug. 1964). (In Russian)

Regularities in the annihilation of ion-radicals formed during γ irradiation at 78°K of the salts NH_4Cl, $N_2H_4 \cdot HCl$, and $N_2H_4 \cdot H_2SO_4$ were investigated. The annihilation mechanism of the ion-radicals in NH_4Cl and $N_2H_4 \cdot HCl$ consists in their recombination with the electrons of the color centers. On the basis of this mechanism, the temperature dependence of the rate of ion radical annihilation in NH_4Cl is explained by the action of light and the fall in the rate constant of recombination with time at constant temperature. (auth)

43515 THE INFLUENCE OF KINETIC FACTORS ON THE DIFFUSED SPREADING OF ZONES IN ION EXCHANGE COMPLEXATION CHROMATOGRAPHY. N. N. Matorina, K. V. Chmutov, N. D. Safanova, and L. V. Shchepetyuk (Inst. of Physical Chemistry, Moscow). Zh. Fiz. Khim., 38: 1942-9(Aug. 1964). (In Russian)

The elution of Eu and Ce by ethylenediamine tetracetate and citrate solutions on the cation exchanger KU-2 (8–10% DVB) was investigated for different flow rates and varying grain size at different temperatures. It was found that the diffused spreading of zones in these cases is due to gel and film kinetics, complexation kinetics in the solution having no appreciable effect. The main cause for the zone spreading differences observed in elution of the rare earth elements with EDTA and H_3Cit is the different rates of the intradiffusion processes. The possibility of determining the spreading out of the zones is discussed. It is shown that in order to compare the experimental and theoretical results diffusion coefficients must be employed, determined by an independent method under conditions corresponding to the elution conditions. (auth)

43516 STANDARD HEAT OF FORMATION OF TANTALUM PENTOXIDE. A. N. Kornilov, V. Ya. Leonidov, and S. M. Skuratov (Moscow State Univ. and Luginin Thermo-chemical Lab., Moscow). Zh. Fiz. Khim., 38: 2008-12(Aug. 1964). (In Russian)

The heat of combustion of metallic tantalum to Ta_2O_5 (α-modification) was determined to be: $\Delta H^0_{298} = -489.3 \pm 0.4$ kcal/mole Ta_2O_5. Two specimens of the metal were used for the determination, both with low and accurately determined amounts of impurities. The heats of combustion of the specimens corrected for the impurities coincided, which is evidence of their correct chemical analysis. The percentage of combustion (99.5–99.9%) was determined by two independent methods that gave coinciding results. (auth)

43517 STANDARD HEAT OF FORMATION OF NIOBIUM PENTOXIDE. A. N. Kornilov, V. Ya. Leonidov, and S. M. Skuratov (Moscow State Univ. and Luginin Thermochemical Lab., Moscow). Zh. Fiz. Khim., 38: 2013-18 (Aug. 1964). (In Russian)

Coinciding results for the heat of combustion of niobium were obtained, utilizing preparations of different origin that contain low amounts of impurities, and it was found that ΔH^0_f Nb_2O_5 (β-modification) is -453.5 ± 0.4 kcal/mole. (auth)

43518 THE RELATIVE DIFFERENCES IN MOBILITIES OF ISOTOPIC K^{39} AND K^{41}. V. P. Troshin (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Fiz. Khim., 38: 2062-3(Aug. 1964). (In Russian)

A method is suggested for determining the relative differences in isotopic potassium ion mobility. Measurements of the relative differences in ion mobilities of ^{39}K and ^{41}K in aqueous solutions of KCl, K_2SO_4, and KNO_3 were determined. (R.V.J.)

43519 INVESTIGATION OF ISOTOPIC EFFECTS IN THE DISSOCIATION OF CARBON DIOXIDE IN GLOW DISCHARGE. I. A. Semiokhin, V. K. Korovkin, G. M. Panchenkov, and Kh. S. Bakhchevskii (Moscow State Univ.). Zh. Fiz. Khim., 38: 2072-6(Aug. 1964). (In Russian)

Studies were made of oxygen and carbon isotope distribution in carbon dioxide and the products of its decomposition in a silent electric discharges at initial pressures of 100, 300, 500, and 700 mm Hg and discharge power from 4 to 8 and 70 to 100 v. At a given discharge power the enrichment coefficients for oxygen and carbon isotopes reach an equilibrium value. The effective separation coefficients do not depend on the discharge power or initial gas pressure. The oxygen product is enriched in ^{18}O and carbon dioxide is stripped of ^{13}C and ^{18}O. (R.V.J.)

43520 REDISTRIBUTION OF OXYGEN AND CARBON ISOTOPES BETWEEN CARBON DIOXIDE AND ITS DISSOCIATION PRODUCTS IN THE SILENT DISCHARGE WITH GAS CYCLING. Yu. P. Andreev, I. A. Semiokhin, and G. M. Panchenkov (Moscow State Univ.). Zh. Fiz. Khim., 38: 2087-91(Aug. 1964). (In Russian)

Studies were made of isotopic distribution during carbon dioxide decomposition in a glow discharge. Oxygen and carbon redistribution takes place between carbon dioxide and oxygen and carbon oxide with ^{18}O and ^{13}C accumulating in CO_2, O_2, ^{12}C, and ^{16}O in CO. Variations of the discharge current from 100 to 600 ma at 30, 50, and 100 mm Hg do not effect the distributions. Initial pressure reduction from 100 to 30 mm Hg increased CO_2 dissociation from 48 to 80%. (R.V.J.)

43521 PROPERTIES OF FINE-GRAIN NUCLEAR EMULSIONS AS A FUNCTION OF pAg AND THE TEMPERATURE OF EMULSIFICATION AND RIPENING. V. I. Zakharov. Zh. Nauchn. i Prikl. Fotogr. i Kinematogr., 9: No. 1, 21-6(Jan.-Feb. 1964). (In Russian)

The presence of silver impurity centers on the surface and inside the crystals produced by emulsion synthesis in saturated silver resulted in a high relativistic sensitivity of fine-grain emulsions (40 to 50 grains per 100 μ). Increased temperatures increased the rate of ripening and maximum sensitivity. (R.V.J.)

43522 COMPLEXING OF ZIRCONIUM WITH DIETHYLENTRIAMINEPENTA-ACETIC ACID AND 1,2 DIAMINE CYCLOHEXANETETRA-ACETIC ACID. L. N. Pankratova, L. V. Vlasov, and A. V. Lapitskii. Zh. Neorgan. Khim., 9: 1363-8(June 1964). (In Russian)

Reactions of Zr(IV) with 1,2-diamino cyclohexanetetra acetic acid (CHTA) and diethylentriaminopenta acetic acid (DTPA) were studied using an ion exchange method. The alterations in the equilibrium constants during zirconium complexing are described by the series: IMDA < CHTA ≤ DTPA < EDTA < NTA. The equilibrium constants for zirconium complexes with DTPA and CHTA were found to be 1.28×10^{-5} and 4.32×10^{-5}, respectively. (R.V.J.)

43523 REACTIONS OF SAMARIUM(III) CHLORIDE WITH SODIUM, POTASSIUM, RUBIDIUM, AND CESIUM CHLORIDES. B. G. Korshunov, D. V. Drobot, V. V. Bukhtiyarov, and Z. N. Shevtsova (Inst. of Fine Chemical Tech., Moscow). Zh. Neorgan. Khim., 9: 1427-30(June 1964). (In Russian)

A thermal analysis was made of $SmCl_3$ complexing with alkali metal chlorides. Constructed phase diagrams showed that the $SmCl_3$–NaCl system formed an incongruently melting compound Na_2SmCl_5; the $SmCl_3$–KCl, $SmCl_3$–RbCl, and $SmCl_3$–CsCl systems melted congruently forming $MeSm_2Cl_7$ and Me_3SmCl_6 compounds. The stabilities of the formed compounds increased regularly from potassium to cesium. In addition, the $SmCl_3$–KCl and $SmCl_3$–RCl systems formed incongruently melting compounds of Me_2SmCl_5. The specific gravities of the low-temperature modifications were determined. It was postulated that the complex ion $(SmCl_3)^{2-}$ is present in $SmCl_3$–NaCl and $(SmCl_6)^{3-}$ in $SmCl_3$–MeCl. (R.V.J.)

43524 CERIUM(III) CHLORIDE SOLUBILITY IN WATER AND SALT SOLUTIONS. A. D. Sheveleva, R. L. Bogdanovskaya, E. F. Zhuravlev. Zh. Neorgan. Khim., 9: 1435-40(June 1964). (In Russian)

Studies were made of the $CeCl_3$ solubility at 10, 20, 30, 40, and 50°C and of the combined solubility and composition of saturated solutions of $CeCl_3$–NaCl–H_2O and $CeCl_3$–KCl–H_2O at 30 and 50° and $CeCl_3$–$CuCl_2$–H_2O at 20 to 50°C. No binary salts or solid solutions were formed. In all cases $CeCl_3 \cdot 7H_2O$ and $CuCl_2 \cdot H_2O$ appeared as solid phases. (R.V.J.)

43525 YTTRIUM, POTASSIUM AND SOME RARE EARTH HYDROXYCITRATES. N. A. Skorik and V. V. Serebrennikov. Zh. Neorgan. Khim., 9: 1483-5(June 1964). (In Russian)

Separation of hydroxycitrates with composition $K[LnCitOH] \cdot xH_2O$ (where Lu is Y, La, Pr, Nd, Sm, Gd, Tb, Dy, or Yb) was achieved, and the structures of the compounds were analyzed. (R.V.J.)

43526 ENTHALPY OF THE OXIDATION OF URANIUM(IV) SULFATE TETRAHYDRATE AND OCTAHYDRATE BY HYDROGEN PEROXIDE. L. M. Vidavskii, V. Yu. Kovalchuk, N. I. Byakhova, and E. A. Ippolitova (Moscow State Univ.). Zh. Neorgan. Khim., 9: 1489-91 (June 1964). (In Russian)

The enthalpy of uranium(IV) sulfate tetrahydrate and

octahydrate oxidation with hydrogen peroxide is $\Delta H = -62.544 \pm 0.080$ kcal/mole and $\Delta H = -54.141 \pm 0.044$ kcal/mole, respectively. The enthalpy of $U(SO_4)_2 \cdot 4H_2O + 4H_2O \rightarrow U(SO_4)_2 \cdot 8H_2O$ is $\Delta H_{293} = -8.40 \pm 0.12$ kcal. (R.V.J.)

43527 IONIZATION OF CERTAIN RARE EARTHS ON THE TUNGSTEN, RHENIUM, AND IRIDIUM SURFACES. N. I. Alekseev and D. L. Kaminskii (Ioffe Inst., of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 34: 1521-5(Aug. 1964). (In Russian)

Surface ionization coefficients were measured for rare earths on the surface of W, Re, Ir, K (from KCl) and Cs (from CsCl). The surface ionization method was used for measuring ionization potentials for Sm, Eu, Dy, Ho, Tm, and Lu. (tr-auth)

43528 THE CHEMISTRY OF COMPLEX CYANIDES. A LITERATURE SURVEY. M. H. Ford-Smith (Gt. Brit. Dept. of Scientific and Industrial Research and Gt. Brit. National Chemical Lab., Teddington, Middx., England). London, Her Majesty's Stationery Office, 1964. 99p. 27s 6d.

Chemical and physicochemical properties of complex cyanides and mixed complex cyanides are given. Information is also given on the properties of the complex cyanides of every element reported to form such complexes, each element being treated separately. The elements include: Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, Ge, Mo, Tc, Ru, Rh, Pd, Ag, Cd, W, Re, Os, Ir, Pt, Au, Hg, Tl, Pb, Po, and U. 420 references are included. (P.C.H.)

43529 PROCEEDINGS OF THE CONFERENCE ON METHODS OF PREPARING AND STORING MARKED MOLECULES, BRUSSELS, NOVEMBER 13-16, 1963. J. Sirchis, ed. European Atomic Energy Community, 1964. 1377p. (EUR-1625.e; CONF-441)

Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules are presented. In Part I the 69 papers and the discussions are given in the original language, and in Part II the English translations of these texts are presented. Separate abstracts were prepared for 66 of the papers. The three remaining papers were previously abstracted and appeared in Nuclear Science Abstracts as 18: 33614, 18: 10122, and 18: 31120. (M.C.G.)

For abstracts of individual papers see: 43214, 43215, 43439, 43530, 43531, 43532, 43533, 43552, 43553, 43554, 43555, 43556, 43557, 43558, 43559, 43560, 43561, 43562, 43563, 43564, 43565, 43566, 43567, 43568, 43569, 43570, 43571, 43572, 43573, 43574, 43575, 43576, 43577, 43578, 43579, 43580, 43581, 43582, 43583, 43584, 43585, 43586, 43587, 43588, 43589, 43590, 43591, 43592, 43593, 43594, 43595, 43596, 43597, 43598, 43685, 43686, 43687, 43688, 43689, 43690, 43691, 43692, 43693, 43694, 43695, and 43696.

43530 THE LABELLING OF ORGANIC COMPOUNDS IN GASCHROMATOGRAPHIC COLUMNS. H. Elias (Technische Hochschule, Darmstadt, Ger.). p.1205-15 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

The labeling of volatile organic compounds in gas-chromatographic columns was found to offer several advantages over isotopic exchange reactions in solution. The labeled compounds can be obtained directly in pure form, because the labeling and purification take place simultaneously. Very small amounts can be labeled and isolated. The exchange is faster in gas-chromatographic columns (partly because of higher temperatures). Due to the special properties of columns a higher specific activity can be obtained by a single pass through the column than by a single exchange in solution, the specific activities at the start being the same. The same holds for repeated use of the column. A gas-chromatographic column, containing approximately 10% sorbitol on diatomaceous earth as stationary phase was labeled with tritiated water; the result was a complete exchange of the hydroxyl hydrogens. With this column organic compounds may be tritiated, which contain sufficiently acidic hydrogen or hydrogens bound to sufficiently basic nitrogen (alcohols, phenols, carboxylic acids, amines); thereby relatively high specific activities can be obtained. In the same manner organic halides can be labeled in a column containing suitable inorganic halides on diatomaceous earth as stationary phase. (auth)

43531 SOME EXAMPLES OF UTILISATION OF DEUTERATED ORGANIC COMPOUNDS IN PHYSICAL CHEMISTRY. Marie-Louise Josien (Université, Paris). p.1225-36 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Uses of deuterium-labeled compounds in chemical reaction analysis, in studies of nonlocalized molecular interactions, and in infrared spectroscopy are discussed and examples given. (M.C.G.)

43532 DETERMINATION OF MOLECULAR WEIGHT OF UNKNOWN NATURAL SUBSTANCES BY DOUBLE MARKING. P. E. Schulze (Hauptlaboratorium der Schering AG, Berlin) and M. Wenzel. p.1271-80 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Labeling of unknown natural compounds with radioisotopes for help in determining their constitution and molecular weight is discussed. After labeling with tritium and isolation of the required radiochemically pure material, its specific radioactivity is determined. By means of this known specific activity (dpm/γ) of the tritiated compound, the structure of which is unknown, the weight of the substance can be calculated by measuring the absolute activity (μC). The tritiated compound can then be reacted with ^{14}C-labeled reagents of known molar specific activity (dpm/μmole) and after isolation and measuring of both the activities contained in the derivative, the molecular weight or its equivalent can be computed as long as the number of groups reacting per mole is known. There is no need for isolating the derivative quantitatively since the basis of calculation is not an absolute measurement, but the quotient of ^{3}H and ^{14}C activity. This method for the determination of the molecular weights of unknown natural substances is described for several compounds where quantities of substance between 5 to 20 γ are employed. The tolerance of determined molecular weights was between 0.4 and 4.5%. The theoretical molecular weights were within this range of tolerance. (auth)

43533 A NEW TECHNIQUE FOR THE STUDY OF ION-MOLECULE REACTIONS AT ATMOSPHERIC PRESSURE BY MEANS OF DOUBLY LABELLED SUBSTANCES. F. Cacace (Università, Rome). p.1339-45 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

A technique involving the use of doubly labeled compounds for the study of the reactions of organic ions at atmospheric pressure is proposed. According to this method, a doubly tritiated molecule is allowed to decay in the presence of a suitable gaseous hydrocarbon. The

decay of one of the two ^3H atoms causes the labeled molecule to dissociate. Mass spectrometric work of Wexler and Snell & Pleasonton previously on monotritiated hydrocarbons demonstrated that in a preponderant fraction of the decays the direct daughter ion loses a neutral ^3He atom, giving an organic ion. Moreover, in the case of tritiated methane, ethane, etc., the results of mass spectrometric work showed that a large fraction of the organic ions resulting from the loss of the ^3He atom have insufficient excitation energy to dissociate further. Therefore, when a doubly tritiated molecule decays, it dissociates to give a labeled ion. These tritiated ions are allowed to react with a suitable hydrocarbon at atmospheric pressure. The labeled reaction products can be separated and determined by radio-gas-chromatographic methods. The application of this technique as a general tool for study of ion-molecule reactions is discussed. (auth)

43534 RESULTS OBTAINED IN RESEARCH ON CHARACTERISTICS OF TRAPPING OF IODINE-131 BY ACTIVATED CHARCOAL. F. Billard, G. Chevalier, J. Pradel (Commissariat à l'Énergie Atomique, Paris). 14p. (CONF-337-55).

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The effects of the physical characteristics of activated charcoal on its capacity to trap ^{131}I were studied. The devices and the techniques used are described. The efficiency of the charcoal was independent of the iodine concentration between 0.1 mCi and 3 Ci. The logarithm of the efficiency of a filtering carbon layer was approximately proportional to its thickness, but the concentration in the last centimeter of the bed was slightly superior to the theoretical values. The coefficient of total purification was approximately inversely proportional to the air velocity. Some incomplete results on the effects of temperature, grain size, activated rate, carbon humidity, and foreign bodies are reported. (J.S.R.)

43535 METHOD OF PREPARING SLUGS OF FUEL OR BREEDER MATERIAL FOR NUCLEAR REACTORS. (to Stichting Reactor Centrum Nederland). French Patent 1,267,627. June 12, 1961. Priority date Sept. 18, 1959, Netherlands.

Ceramic fuel pellets were prepared by mixing a ceramic fuel, e.g., UO_2, with a minor amount of a MgF_2 or CaF_2 gel, which contains NH_4Cl or UO_2SO_4 as a gelling agent, compacting the mixture, and drying the compacts at 50 to 400°C. (NPO)

43536 OXYCHLORIDES OF PENTAVALENT NEPTUNIUM. Theodore J. La Chapelle, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,149,908. Sept. 22, 1964.

The preparation of oxychlorides of pentavalent neptunium, i.e., neptunium monoxy-trichloride or neptunium dioxy-monochloride, is described. The process involves dehydration of a solution of pentavalent neptunium ions in a mixture with chloride ions under specific conditions to produce the oxychloride compounds. In the presence of excess chloride, the trichloride compound is formed and with stoichiometric equivalents, the monochloride is formed. (AEC)

43537 OXIDATION RESISTANT CERIUM ALLOYS. Karl L. Gschneidner, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,149,966. Sept. 22, 1964.

A method for preparing and properties of a ductile non-oxidizing malleable cerium alloy containing at least 10 atomic percent of an oxidizing inhibitor consisting of scandium or lutetium are discussed. (AEC)

43538 PRETREATMENT OF URANIUM DIOXIDE TO PROMOTE ITS CONVERSION TO URANIUM TETRAFLUORIDE. S. H. Smiley, D. C. Brater, and C. C. Littlefield (to U. S. Atomic Energy Commission). U. S. Patent 3,150,924. Sept. 29, 1964.

An improvement was made in the process for preparing uranium hexafluoride from a uranyl nitrate solution, which consists of continuously calcining the uranyl nitrate in an agitated bed of uranium trioxide, reducing the resulting uranium trioxide to uranium dioxide with hydrogen, reacting the uranium dioxide with hydrogen fluoride to form uranium tetrafluoride, and reacting the uranium tetrafluoride with fluorine. The improvement consists of slightly reoxidizing the uranium dioxide after reduction to improve its reactivity with hydrogen fluoride. Substantially increased production rates were obtained in the processing of continuously calcined uranium trioxide feed material, which otherwise is extremely unreactive in the hydrofluorination step. (AEC)

43539 PREPARATION OF SCANDIUM HYDRIDES. Charles P. Kempter and Joseph C. McGuire (to U. S. Atomic Energy Commission). U. S. Patent 3,152,868. Oct. 13, 1964.

A process was developed for the preparation of scandium dihydrides. It consists of heating scandium metal in the presence of a hydrogen isotope at a temperature of about 450°C and at slightly less than atmospheric pressure. (AEC)

43540 PROCESS FOR PREPARING URANIUM MONOCARBIDE. Alfred Schneider, Leslie Burris, Jr., and Stephen Lawroski (to U. S. Atomic Energy Commission). U. S. Patent 3,154,378. Oct. 27, 1964.

A process of producing uranium monocarbide by precipitation with carbon from a molten uranium solution in cadmium, zinc, cadmium–zinc, magnesium–zinc, or magnesium–cadmium at 500 to 850°C is described. (AEC)

Organic Chemistry

43541 (LA-3132-MS(p.242-4)) THE CONVERSION OF MONO- AND OLIGODEOXYRIBONUCLEOTIDES TO THEIR 5′-TRIPHOSPHATES. D. E. Hoard and D. G. Ott (Los Alamos Scientific Lab., N. Mex.).

A method is described for the chemical synthesis of mono- and oligonucleotides bearing a 5′-triphosphate group. It appears to be universally applicable and particularly useful for small-scale reactions with isotopically labeled compounds. (C.H.)

43542 (LA-3132-MS(p.252-7)) CHEMICAL POLYMERIZATION OF A TRINUCLECTIDE. V. N. Kerr (Los Alamos Scientific Lab., N. Mex.).

Oligodeoxyribonucleotides of known structure and with sufficient size to act as templates in an RNA synthetase system were desired for use as models in a study of the overall DNA coding of protein synthesis. Where polymerization of known trimers was feasible, oligomers with repeating three-unit codons could be obtained. Initial experiments performed in an attempt to find optimum conditions for the chemical polymerization of the smaller units are described. The trimer of 5′-thymidylic acid, $(pt)_3$, was used throughout the series of experiments, and the relative effectiveness of three polymerizing reagents was tested. (C.H.)

43543 (LA-3132-MS(p.258-62)) CHEMICAL STUDIES ON NUCLEOTIDE POLYMERIZATION. A. Murray (Los Alamos Scientific Lab., N. Mex.).

Studies on polymerization of 5′-thymidylic acid were continued in search for reaction conditions to improve the yield of higher oligomers through a critical comparison of the two condensing reagents dicyclohexylcarbodiimide and picryl chloride. The possibility of polymerizing a small oligonucleotide without violating the resultant base order was investigated. Preparative chromatographic separation of the various reaction products was studied. (M.C.G.)

43544 (LA-3132-MS(p.263-9)) OLIGODEOXYRIBONUCLEOTIDE SYNTHESIS. D. L. Williams, V. N. Kerr, and R. E. Hine (Los Alamos Scientific Lab., N. Mex.).

The stepwise synthesis of oligodeoxyribonucleotides is discussed. Of interest in the synthesis of higher oligonucleotides of known base sequence are the completely blocked dinucleotides such as 5′-O-(dimethoxytrityl)-thymidylyl-(3′ : 5′)-3′-O-acetylthymidine and 5′-O-(dimethoxytrityl)thymidylyl-(3′ : 5′)-3′-O-acetyl-N^6-anisoyldeoxycytidine. The acid-labile trityl group and base-labile ester linkages may be selectively removed to permit further phosphorylation reactions at either the 5′- or 3′-hydroxyl positions. Using published procedures, or modifications of these and suitably protected intermediates, the following deoxyribonucleotide dimers were prepared: tpt, ptpt, tptp, ptptp, cyc-ptpt, tpc, ptpc, tpcp, ptpcp, and cpc. Following the removal of protective groups, these compounds were isolated by chromatography on DEAE-cellulose columns with linear gradients of triethylammonium bicarbonate. Calcium, lithium, or sodium salts were prepared for characterization. A list of nucleosides, nucleotides, and dinucleotides with paper chromatographic Rf values in several solvents is presented. (C.H.)

43545 (LA-3132-MS(p.270-2)) SYNTHESIS OF LABELED DEOXYNUCLEOTIDE DIMERS. D. L. Williams (Los Alamos Scientific Lab., N. Mex.).

The thymidine dimer, tpt, labeled with tritium, was prepared. Methods and results are described. (C.H.)

43546 (TID-21141) A STUDY OF RAPID ORGANIC OXIDATION REACTIONS. Second Annual Technical Report. Kenneth B. Wiberg (Yale Univ., New Haven). [1964]. Contract AT(30-1)-3149. 5p.

Progress on the following three topics is summarized: oxidation of aldehydes with permanganate, oxidation of aldehydes with ceric ion, and ferricyanide oxidation of mercaptans. (N.W.R.)

43547 (ORNL-tr-334) AN IMPROVED METHOD FOR SYNTHESIS OF ETHYLENE OXIDE. Martin A. Carter. Translated for Oak Ridge National Lab., Tenn., from Japanese Patent 19,103. Feb. 23, 1960. 4p.

An improvement is made in the method for the silver-catalyzed oxidation of ethylene. In the method, pure O_2 is used instead of air, and a dilute aqueous solution of ethylene oxide is the product. An apparatus for carrying out the method is described. (D.L.C.)

43548 AN IMPROVED SYNTHESIS OF P^{32}-2-CYANOETHYL PHOSPHATE. K. E. Pfitzner and J. G. Moffatt (Syntex Inst. for Molecular Biology, Palo Alto, Calif.). Biochem. Biophys. Res. Commun., 17: 146-9(Sept. 22, 1964).

It was found that a completely specific and efficient synthesis of ^{32}P-labeled 2-cyanoethyl phosphate results from the reaction of triethylammonium-^{32}P-orthophosphate with excess 2-cyanoethanol and trichloroacetonitrile. The reaction was found to be almost complete within 15 min at room temperature. Paper chromatography of the product showed the presence of two very minor impurities: the orthophosphate (0.7% of the total ^{32}P) and perhaps 2-cyanoethyl diphosphate (1.7%). The specific activity was 10 μC per mole. (M.C.G.)

43549 PROTON TRANSFERS IN DIPOLAR APROTIC SOLVENTS. I. TRANSFERS TO FLUORENYL AND TRITYL ANIONS IN DIMETHYL SULFOXIDE SOLUTION. Calvin D. Ritchie and Ronald Uschold (State Univ. of New York, Buffalo). J. Am. Chem. Soc., 86: 4488-9(Oct. 20, 1964).

Results of competitive proton abstractions from several types of acids by the triphenylmethyl (trityl) and fluorenyl anions in dimethyl sulfoxide (DMSO) solutions are reported. They indicate that diffusion control may be a general characteristic of proton transfer reactions in such solvents, independent of the nature of the acid and base involved. A hypothesis that the ionization of a carbon acid in hydroxylic solvents must involve a large amount of solvent reorganization and that a major part of the activation energy is connected with this solvent reorganization is suggested. (M.C.G.)

43550 SPECTRAL STUDY OF THERMOLUMINESCENCE FROM AROMATIC AMINO ACIDS. Svein Prydz and Thomas Roegeberg (Universitet, Oslo). Phys. Norvegica, 1: 227-33(1964).

Polycrystalline aromatic amino acids were exposed to x rays at the temperature of boiling air, and the spectral distribution (between 400 and 800 nm) of the thermoluminescence emitted was determined using a sensitive spectrograph. A heating rate of 5 to 6°/min was used. For tyrosine and tryptophan, satisfactory spectra were obtained at temperatures between 100 and 160°K. No significant change in spectral shape with temperature was observable. The results obtained were compared with those obtained by Weinberg by means of filters. (auth)

43551 PREPARATION OF ORGANIC CHLOROSILANES LABELED BY RADIOCARBON ^{14}C. A. A. Efremov and Ya. D. Zel'venskii. Zh. Obshch. Khim., 34: 2622-5(Aug. 1964). (In Russian)

Preparation of phenyltrichlorosilane-^{14}C, phenyldichlorosilane-^{14}C, and dimethylphenylchlorosilane-^{14}C from benzene-^{14}C is described, and a method for the preparation of methylchlorosilane from methyliodide-^{14}C is given. (R.V.J.)

43552 TRITIUM LABELING BY CATALYTIC EXCHANGE. H. A. Smith (Univ. of Tennessee, Knoxville) and M. Lindauer. p.171-7 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Studies showed that rapid exchange takes place between hydrogen in the gas phase and the carboxyl hydrogen of an organic acid when the two are brought into contact in the presence of a catalyst such as platinum or rhodium. When isotopic hydrogen, either deuterium or tritium, is used in the gas phase, the isotope is incorporated into the organic molecule, but the labeled hydrogen is quite labile, and hence is in itself not very useful for tracer purposes. The labile hydrogen atom may be stabilized by decarboxylation of the organic acid so that the isotopic hydrogen becomes directly attached to carbon, or the tagged acid may be heated with certain other organic compounds in the presence of a catalyst so that exchange takes place, which allows labeling of the new molecule. Thus an unsaturated compound can be tagged by this method without accompanying hydrogenation. Ethylene and cis- and trans-dichloroethylene were tagged by this procedure. The cis compound was labeled much more readily than the trans form. The

method may be used successfully with pure deuterium or tritium or with relatively low mole fractions of these in the hydrogen gas, and involves virtually no side reactions. (auth)

43553 SYNTHESES OF STEREOSPECIFICALLY MARKED STEROLS AND BILE ACIDS AND THEIR USE IN STUDIES OF BIOSYNTHETIC MECHANISMS. B. Samuelsson (Karolinska Institutet, Stockholm). p.251-4 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Syntheses of cholic acid labeled specifically with tritium in positions 6α, 6β, 7β, and 8β and cholesterol labeled in position 6 are described. The use of these compounds in studies of reaction mechanisms during the biosynthesis and metabolism of bile acids and a study on the stereochemistry of hydrogen transfer to squalene during its biosynthesis from farnesyl pyrophosphate is reported. (auth)

43554 BIOLOGICAL PREPARATION OF LABELLED COMPOUNDS. J. R. Catch (Radiochemical Centre, Amersham, Bucks, Eng.). p.293-300 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Biological methods of labeling compounds are reviewed. Both purified enzymes and intact cells are used in the labeling processes. Photosyntheic production of labeled compounds in algae, higher plants, and detached leaves is described. Advantages and disadvantages of the various biological methods are summarized, and problems and prospects are outlined. (M.C.G.)

43555 IODINATION OF PROTEINS TO HIGH SPECIFIC ACTIVITY. R. Banerjee, R. P. Ekins, J. Ellis, C. Lowy, and J. O'Riordan (Middlesex Hospital, London). p.481-92 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Development of immuno- (or saturation) assay techniques for measurement of small amounts of various protein hormones in blood led to a demand for radioiodinated proteins of very high specific activity. Two methods were utilized in iodinating insulin to specific activities of between 100 mC and 1.5 C/mg, in iodinating glucagon to approximately 500 mC/mg and other proteins in the range of 10 to 100 mC/mg. The first method entails the use of Conway microdiffusion units in which the protein to be iodinated is placed in the central compartment and the radioiodide-oxidizing agent mixture is in the outer annulus. Elemental iodine, diffusing into the protein compartment, iodinates the protein under conditions of minimal chemical trauma. Overall iodination efficiency in a glass unit was about 30 to 40% and specific activities of up to 200 mC/mg insulin were attained using 5 mC ^{131}I. The diffusion characteristics of iodine in microamounts in the Conway unit were studied. Chloramine-T is commonly employed in the oxidation of iodide to iodine and the consequent iodination of protein and other organic molecules. Though this technique entails mixing the oxidizing reagent with the material to be iodinated, iodination efficiency is high and, provided a satisfactory purification procedure is available, extremely high specific activities are attainable. The use of this technique in the preparation of ^{131}I-insulin of specific activities up to 1.5 C/mg and the subsequent purification of this material to above 95% immunochemical purity is described. (auth)

43556 ON THE PREPARATION OF [^{131}I]-IODOTYROSINES OF VERY HIGH SPECIFIC ACTIVITIES AND ON SOME OF THEIR PROPERTIES. W. S. Reith and W. Tampion (Middlesex Hospital Medical School, London). p.523-9 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

L-tyrosine was iodinated with [^{131}I]-iodide by a method previously developed. It was found advantageous to use less than 0.5 μg of l-tyrosine. So, generally, for the preparation of [^{131}I]-monoiodotyrosine amounts around 0.1 μg of l-tyrosine were used; while for the preparation of [^{131}I]-diiodotyrosine amounts around 0.05 μg of l-tyrosine were used under otherwise identical conditions of volumes and concentrations. In a large number of preparations minimal specific activities of 300 mC/μ mole for [^{131}I]-monoiodotyrosine, and of 600 mC/μ mole for [^{131}I]-diiodotyrosine were generally obtained. However, these activities varied appreciably. The reaction temperature was kept at 23°C. Work on determination of the actual specific activity using ^{14}C-labeled l-tyrosine of known specific activity is being carried out. Experimental work studying the stability of these substances in various buffer solutions at various temperatures, and also on other conditions of storage is in progress. (auth)

43557 SYNTHESIS OF DEUTERATED n-HEXANOLS AND n-HEXANALS. R. N. Renaud and L. C. Leitch (National Research Council, Ottawa). p.657-8 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

In order to elucidate rearrangements induced by electron impact, the following deuteriated n-hexanols and hexanals were synthesized: $CD_3(CH_2)_4CH_2OH$, $CD_3(CH_2)_4CHO$, $CH_3CD_2(CH_2)_3CH_2OH$, $CH_3CD_2(CH_2)_3CHO$, $CH_3CH_2CD_2(CH_2)_2$-CH_2OH, and $CH_3CH_2CD_2(CH_2)_2CHO$. Of several possible routes studied, the lengthening of the carbon chain of suitably labeled n-propyl bromides with trimethylene oxide appeared to be the most promising. The yields obtained in this reaction were only 30 to 35% but they enabled the desired compounds to be obtained in one step. The labeled n-propyl bromides were obtained commercially. The oxidation of the tosylates of the alcohols to the aldehydes was carried out with dimethyl sulfoxide. A method of isolating the aldehydes themselves rather than their dinitrophenylhydrazones was worked out. The yields based on the alcohols were 60%. (auth)

43558 SYNTHESIS OF DIACETYLENE-2,3-^{13}C. R. N. Renaud and L. C. Leitch (National Research Council, Ottawa). p.659-61 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Diacetylene-2,3-^{13}C was prepared by the following method: $H^{13}C \equiv {}^{13}CH + (CH_2O)_n \rightarrow HOCH_2{}^{13}C \equiv {}^{13}CCH_2OH \xrightarrow{SOCl_2}$ $ClCH_2{}^{13}C \equiv {}^{13}CCH_2Cl \xrightarrow{KOH} HC \equiv {}^{13}C-{}^{13}C \equiv CH$. Butyne-2,3-$^{13}C$-1,4-diol was prepared in two ways. Valette's modification of the Reppe synthesis from acetylene and formaldehyde on a copper acetylide catalyst gave a product which contained butylene glycol when acetylene prepared from barium carbide was employed. Alternatively, the labeled butynediol was prepared in 50% yield by improving the synthesis of Dupont, Iotsisch, and Lespiau from dimagnesium acetylide and polyoxymethylene. The dichlorobutyne-2,3-^{13}C was prepared from the diol in 82% yield with thionyl chloride in pyridine. Dehydrochlorination of the chloride with alkali as described by Armitage, Jones, and Whiting gave 1,3-diacetylene-2,3-^{13}C in 60% yield. (auth)

43559 RECENT SYNTHESES OF ORGANIC COMPOUNDS LABELLED WITH THE ISOTOPES OF OXYGEN (^{17}O AND ^{18}O). D. Samuel (Weizmann Inst. of Science,

Rehovoth, Israel). p.705-10 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Since the radioactive isotopes of oxygen (^{14}O, ^{15}O, ^{19}O, and ^{20}O) have half lives of two minutes or less, stable isotopes (^{17}O and ^{18}O) are used for tracer work. The primary source of these isotopes is water produced by fractional distillation, or enriched oxygen gas separated by thermal diffusion. The main methods of syntheses from water or oxygen fall into three main groups: oxidation, hydrolytic, and isotopic exchange methods. The oxidation methods, used mainly for inorganic compounds, include direct reaction with oxygen, oxidation in aqueous solution, and electrolytic oxidation. A small number of ^{18}O-labeled organic compounds were synthesized in this manner. ^{18}O-alcohols were synthesized by the reaction of enriched oxygen on a Grignard reagent but other methods were more effective. In the hydrolytic methods organic nitriles, halides, or esters are hydrolyzed in acid or basic solution. Highly enriched benzoic acid-^{18}O, for example, is prepared by hydrolysis of benzonitrile in concentrated HCl solution. Labeled acetic acid can be produced by a variety of hydrolytic methods depending on the enrichment required. Alcohols labeled with ^{18}O or ^{17}O can be synthesized only from esters that hydrolyze with C–O bond fission. Phenols can be made from arylhalides, but better yields are obtained from the hydrolysis of diazonium salts. Isotopic exchange of oxygen between various compounds and water is one of the simplest methods of synthesis but necessarily causes isotopic dilution. High enrichments can only be obtained by successive stages of exchange. However, this method is in many cases the only one available. A method of synthesis that may be particularly useful for alcohols is isotopic exchange between ^{18}O-labeled alumina and various compounds such as cetyl alcohol and cholesterol. (auth)

43560 SOME ASPECTS OF THE CHEMICAL SYNTHESIS OF MARKED MOLECULES. L. Pichat (CEN, Gif sur Yvette, France). p.763-86 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

The preparation of carbon-14-labeled potassium cyanide, sodium formate, and barium cyanamide starting from $^{14}CO_2$ is described. The importance of Grignard reagents for preparation of labeled compounds and their use in preparation of phenylalanine-3-^{14}C, nor-adrenalin-β-^{14}C, squalene-11, 14-^{14}C, and anthrathrene-^{14}C are discussed. Preparation of tritium-labeled molecules by the Wilzbach method and modifications, by exchange reactions with tritiated water by heterogeneous catalysis, by exchange of labile protons, by catalytic addition to unsaturated or acetylenic precursors, catalytic dehalogenation of halogenated aromatic compounds, and hydrolysis of organometallic derivatives with tritiated water is described. Other topics discussed include: handling volatile compounds and gases, purification and isolation by chromatography, checking radiochemical purity, and storage problems due to autodecomposition. (M.C.G.)

43561 THE MARKING OF TROPANE-ALKALOIDS WITH RADIOISOTOPES. G. Werner and H.-L. Schmidt (Max-Planck-Institut fur Hirnforschung, Frankfurt am Main). p.791-7 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

For performance of tracer experiments with tropane-alkaloids atropine, scopolamine, and (–)-cocaine were each labeled by ^{14}C on different parts of the molecule. Introduction of ^{14}C in the >N-CH_3-group of the tropane ring was achieved on atropine by total synthesis (Robinson-Schöpf condensation) and on (–)-cocaine and scopolamine by preparation of the corresponding nor-compounds and methylation of the last ones by $^{14}CH_3I$. Methylation of nor-pseudo-cocaine by CTH_2I served for preparation of ^{3}H-(+)-pseudo-cocaine. Radioactive tropic acid was prepared by carbonization of benzyl magnesium chloride with $^{14}CO_2$ and by allowing the phenyl acetic acid to react with formic aldehyde. Its esterification with tropine and scopine yielded atropine and scopolamine labeled in the acid part. Correspondingly ^{14}C labeling of the double ester (–)-cocaine was performed on the benzoyl part and the methanol part of the molecule. Total yields ranged from 45 to 70%. (auth)

43562 SYNTHESIS OF TRITIATED CHLORAMPHENICOL EXCLUSIVELY LABELLED IN THE AROMATIC NUCLEUS. H. L. Otto (TNO, Centraal Laboratorium, Delft, Netherlands). p.799-805 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Tritiated chloramphenicol, D-threo-1-p-nitrophenyl-2-dichloroacetamido-1,3-propanediol, exclusively labeled in the aromatic nucleus, is suitable for study of the antibiotic action of this compound. The high specific activities, required for these investigations, can be obtained with tritium. The nitro group de-activates the electrophylic exchange of aromatic hydrogen and tritium atoms. Consequently, an exchange of tritium for hydrogen from other molecules in the biochemic system is not likely to occur. For a synthesis of labeled chloramphenicol, the possibility of introducing tritium by exchange in D-threo-1-phenyl-2-amino-1,3-propanediol-O,O,N-triacetate was investigated. This compound has the stereochemical configuration of chloramphenicol, and chloramphenicol can be synthesized from it in a relatively simple way. The aromatic hydrogen atoms are not de-activated, because there is no nitro group. The exchange was studied in acidic solution. With a tritiated trifluoroacetic acid-perchloric acid mixture, a considerable decomposition accompanied an only slight exchange of hydrogen. However, with tritiated acetic acid in the presence of platinum catalyst, a sufficient hydrogen-tritium exchange occurred without decomposition. Chloramphenicol was obtained by nitration, hydrolysis of the acetyl groups, followed by dichloroacetylation. Specific activities of 10 mC/m mole could be obtained. From the specific activities of the radiochemically pure chloramphenicol and the p-nitrobenzoic acid, obtained by oxidation, it was concluded that all the tritium atoms are located in the aromatic nucleus. (auth)

43563 PREPARATION OF CARBONYL-^{14}C-MARKED LOWER ALIPHATIC KETONES. K. H. Schweer (Kernforshungszentrum, Karlsruhe, Ger.). p.807-11 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

It was found that by reaction of metal-organic compounds, especially cadmium dialkyls and alkylzinciodides, with ^{14}C-labeled acid chlorides $_3C$-C_8 ketones are obtained in good yields. These ketones are labeled in the carbonyl group. Instead of normally applied aromatic hydrocarbons, which allow only a moderate separation of the ketones, high-boiling ethers were used as solvents. The ketones were isolated by distillation under reduced pressure and purified by a further vacuum distillation. The complexes formed with alkylzinc iodide and acid chloride were thermally destroyed and therefore the ketones obtained were non-aqueous. A comparison of the yields of activity with

the pyrolytic showed that, starting from $Ba^{14}CO_3$, the yields of ketones from this method are about 20% higher than for the pyrolytic method. In the same way asymmetrical ketones can be prepared. (auth)

43564 SATURATION OF DOUBLE BONDS WITH TRITIUM-MARKED HYDRIODIC ACID: PREPARATION OF THYROXINE AND ITS TRITIUM-MARKED ANALOGUES. J. Roche, J. Nunez, C. Jacquemin, and J. Pommier (Collège de France, Paris). p.813-19 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

A method was developed for saturating double molecular bonds whose structure is incompatible with catalytic hydrogenation or the Wilzbach exchange method. The proposed method employs tritium-labeled hydriodic acid, which can be prepared by mixing red phosphorus, iodine, and tritium-labeled water; if the proportions of the three constituents are correct, 57% hydriodic acid is obtained, i.e., the azeotrope that must be used to effect the tritium labeling. By ebullition of the halogenated raw material in a suitable apparatus, it is possible to obtain the ^3H-labeled saturated substance on the positions of the double bond. Recovery, by distillation, of the excess hydriodic acid allows it to be used for another operation. Purification of the compounds obtained is effected by chromatography on Dowex 50 and, if appropriate, by chromatography on paper. Compounds prepared were: thyroxine; 3,5,3′-triiodothyronine; 3,5-diiodothyronine; tyrosine; thyronine; 3′-iodothyronine; 3′,5′-diiodothyronine; 3-iodothyronine; 3,3′-diiodothyronine; and 3,3′5-triiodothyronine. In addition, these various iodothyronines were doubly labeled with ^{125}I or ^{131}I and ^3H, and a method of counting the two isotopes contained in the molecules was developed. Since these molecules are sensitive to air and light, numerous experiments in storing them were carried out and optimal storage conditions were determined. (auth)

43565 SEMI-MICROSYNTHESIS OF CHOLESTERYL ^{14}C-4 ARACHIDONATE AND LINOLENATE. A. Crastes de Paulet and L. Bardou (Inst. of Biology, Montpellier, France). p.821-30 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

A procedure was sought for synthesis of labeled cholesterol esters giving high yields on quantities ranging from 5 to 10 mg, without a carrier. In this way, the synthetized ester may have the same activity as the initial product. The transesterification method performed by Mahadevan and Lundberg, on amount of sterols of about 1 gram was found to be suitable for such a purpose. The best conditions of synthesis, procedures of separation, purification, and identification were studied by numerous experiments with non-labeled material. The best yield (40% of pure material) was given by heating, under nitrogen for 7 hours at 80°C, 15 μmole of cholesteryl acetate with 75 μmole of methyl linolenate or arachidonate and 150 μmole of CH_3ONa. The crude product of reaction was submitted to chromatography on a column of silicic acid, with pentane–benzene mixture as eluents. Pure cholesteryl linolenate (or arachidonate) was eluted with pentane–benzene 9/1; the unreacted methyl linolenate or ethyl arachidonate and cholesteryl acetate were eluted with pentane–benzene 8/2, and traces of cholesterol were eluted with pentane–benzene 6/4. No oxidation product was detected. Each fraction eluted was analyzed by thin-layer chromatography. Infrared analysis showed that these samples of cholesteryl linolenate and arachidonate are identical in all respects with literature data. (auth)

43566 PREPARATION OF ^{14}C β-HYDROXYBUTYRIC ACID FROM ^{14}C CARBON DIOXIDE OR ALTERNATIVELY FROM 1- OR 2-^{14}C ACETIC ACID, BY MEANS OF HYDROGEN OXIDIZING BACTERIA. G. Gottschalk and H. G. Schlegel (Universität, Gottingen, Ger.). p.835-7 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Chemical synthesis of ^{14}C-labeled organic compounds from ^{14}C-carbon dioxide is often difficult. It was found that it is comparatively easier to prepare radioactively labeled compounds (^{14}C-glucose, ^{14}C-amino acids) with the help of CO_2-fixing organisms. Oxyhydrogen gas bacteria accumulate fixed CO_2 in the form of poly-β-hydroxybutyric acid (PHBA) at the end of the exponential growth phase. Even young cultures synthesized (PHBA, when they were stirred in a mineral nutrient solution without a nitrogen source in an atmosphere of hydrogen, oxygen, and carbon dioxide. When young cells containing only a little PHBA are exposed to ^{14}C-carbon dioxide, a good yield of uniformly labeled ^{14}C-PHBA of high specific activity is obtained. The incorporation takes only a few hours because of the high metabolic activity of the bacteria. If under similar conditions labeled acetate is supplied 1,3- or 2,4-^{14}C-PHBA is produced. ^{14}C-PHBA can be easily recovered from the freeze-dried cells by chloroform extraction and can be used as the starting material for the production of ^{14}C-β-hydroxybutyric acid, ^{14}C-crotonic acid, and ^{14}C-butyric acid. (auth)

43567 PREPARATION OF UNIFORMLY MARKED D-GALACTOSE AND GLYCEROL ^{14}C. J. P. Aubert and G. Milhaud (Institut Pasteur, Paris). p.839-42 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

The preparation of uniformly ^{14}C-labeled d-galactose and glycerol is based on the fact that a red marine alga Rhodimenia palmata synthetizes an α-glycerol-d-galactoside. After photosynthesis in an atmosphere of $^{14}CO_2$, the galactoside is extracted with alcohol, then purified by paper chromatography. The purified compound is hydrolyzed by incubating with invertase containing melibiase. With 10 g of alga (wet weight) and from 28 mC $Ba^{14}CO_3$, about 9 mC galactose and 4.5 mC glycerol are obtained. The radioactive purity is higher than 99%; the specific radioactivity is 8 mC/m mole for the galactose and 4 mC/m mole for the glycerol. (auth)

43568 SYNTHESIS OF ^{14}C- AND ^3H- LABELLED POLYUNSATURATED FATTY ACIDS. W. Stoffel (Universitat, Cologne). p.843-54 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Methods for chemical synthesis of polyunsaturated fatty acids were developed in order to elucidate the mechanisms of biosynthesis of highly unsaturated fatty acids. These syntheses permit labeling of the molecule in any position wanted. Methods for the synthesis of oleic, linoleic, and linolenic acid types are outlined. The following purification procedures were applied: crystallization of intermediates, separation by means of mercury adducts, preparative gas chromatography, and countercurrent distribution. With the help of these labeled compounds the decisive mechanisms in experiments in vitro in the biosynthesis of polyunsaturated fatty acids with 20 and 22 carbon atoms were determined, namely the chain elongation and olefination reaction.

The structures of the reaction products of the chemical synthesis were determined. (auth)

43569 BIOSYNTHETIC PREPARATION OF TRITIATED DNA. C. Paoletti and N. Lamonthezie (Institut Gustave Roussy, Villejuif, Seine, France). p.855-65 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

The preparation of DNA specifically labeled on the methyl group of thymine by ^{3}H from normal tissue with rapid cellular turnover, i.e., intestines and spleen (specific activity (SA): 0.1 μC/mg) and from Ehrlich tumor cells (SA: 2 μC/mg) is described. The radiochemical purity is proved by paper chromatography and CsCl gradient ultracentrifugation and confirmed by successive reprecipitations. Several methods of preparation give products of equal specific activity. (auth)

43570 THE PREPARATION AND PURIFICATION OF YEAST RIBONUCLEIC ACIDS LABELLED WITH ^{32}P AND ^{14}C. J. P. Ebel, J. H. Weil, G. Dirheimer, S. Muller-Felter, N. Hebding, and J. Siffre (Université, Strasbourg). p.867-79 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Different types of yeast ribonucleic acids (ribosomal, soluble, and messenger RNA) were prepared using various techniques. These different types of RNA can be obtained labeled either with ^{32}P after addition of ^{32}P to the culture medium, or with ^{14}C after addition of ^{14}C-uracil, or ^{14}C-adenine (labeling the purine bases), or ^{14}C-orotic acid (labeling the pyrimidine bases). Properties of the RNA preparations obtained by various techniques were compared. When the RNA's were prepared from yeast in the stationary phase, the methods used give RNA preparations, which were contaminated by inorganic polyphosphates. Purification methods were developed for elimination of polyphosphates from the RNA preparations. These methods consist of either differential adsorption of the RNA's on charcoal, chromatography, or differences in solubility of quaternary ammonium ribonucleates and polyphosphates in organic solvents. (auth)

43571 ELECTROCHEMICAL LABELLING OF PROTEINS WITH ^{131}I. U. Rosa (SORIN, Centro Ricerche Nucleari, Saluggia, Italy). p.915-30 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

An electrolytical method is proposed as a general tool for radioiodine labeling of proteins. Elemental iodine is set free at the anode by electrolysis of a KI solution in which a protein is dissolved. Preliminary experiments carried out on the amino acids chiefly involved in protein iodination (tyrosine, cysteine, cystine, and histidine) proved that for a proper value of current, i.e., a proper value of elemental iodine in the solution, unwanted oxidative reactions can be reduced. A detailed investigation was carried out on the factors affecting the electrolytic process of human serum-albumine iodination (current density, current intensity, and pH). A technique of microimmunoelectrophoresis on agar was adopted to check possible denaturation occurring in the protein during the iodination process. The results obtained proved that a human serum albumine labeled with ^{131}I at a sufficient specific activity may be produced with a 90% iodination yield and a radioiodine content less than 0.1 atoms/protein molecule. The data obtained from the iodination of serum albumin and free tyrosine solutions showed that the optimum value of current is the same in both cases. The possibility of labeling protein molecules having higher biological specificity, such as antibodies, viruses, and hormones is discussed. Preliminary results on γ-globulin and fibrinogen labeling with ^{131}I are reported. (auth)

43572 PRODUCTION OF SPECIFICALLY LABELLED ACTINOMYCINS. O. Ciferri, A. Albertini and G. Cassani (Università, Pavia, Italy). p.961-7 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Actinomycins are chromopeptides with antibiotic and cytostatic activity produced by species of Streptomycetes. Chemically, the actinomycins are characterized by the presence of a chromophoric phenoxazinone nucleus linked to two peptide chains containing five amino acids each. The selective addition of radioactive amino acids to the growth medium resulted in the production of the following types of actinomycins: actinomycins labeled in the phenoxazinone nucleus only (using benzene-^{14}C-trytophan); actinomycins labeled in the peptide chains only or in a single amino acid of the peptide chain (using ^{14}C-proline, ^{14}C-threonine ^{14}C-valine, ^{14}C-sarcosine, and ^{14}C-isoleucine); actinomycins labeled in the methyl groups of sarcosine, N-methyl-valine, and chromophore (using methyl-^{14}C-methionine); and uniformly labeled actinomycins (using a hydrolyzate of ^{14}C-labeled algal protein). (auth)

43573 TRITIUM LABELLING OF PROTEINS AND PEPTIDES. J. Leonis (Université Libre, Brussels). p.983-95 of "Proceeding of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Experiments were carried out to obtain a range of labeled peptides, of known structure and variable complexity, by means of hydrolysis of labeled proteins. The conditions for tritiating lysozyme and ribonuclease, according to Wilzbach's method, were clarified; procedures for an effective purification of the labeled products were set up. Analysis of the amino acid composition of these proteins was carried out, making possible identification of the preferential tritiation sites in the macromolecules considered. Results indicated that the H-T exchange in side chains is controlled, at least partially, by the spatial configuration of the macromolecule. Two ways of splitting labeled lysozyme into peptides of known structure were investigated. Enzymic hydrolysis by means of trypin liberates a large number of peptides, among which four aromatic peptides were easier to isolate and at the same time had the highest specific radioactivity. Chemical hydrolysis by means of cyanogen bromide is being studied; it was found that this reagent hydrolyzes peptide bonds next to the two methionines of lysozyme, which should make it possible to isolate three peptides containing respectively 12, 24, and 93 amino acids. Subsequent tritium labeling of peptides isolated from unlabeled lysozyme was also considered. (auth)

43574 THE TRITIUM-MARKING OF SUGARS AND CERTAIN CARBOXYLIC ACIDS WITH ENZYME REACTIONS AND/OR WILZBACH MARKING. H. Simon, G. Muellhofer, and H. D. Dorrer (Technische Hochschule, Munich). p.997-1004 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Intramolecular tritium distribution was studied in organic molecules, which were tritium labeled by the Wilzbach method. Sixteen hexoses, pentoses, and their derivatives were purified and degraded. In most cases the tritium distribution showed pronounced deviations from uniform distribution: with D-glucose, for example, ap-

proximately 90% of the tritium content was present at the C-3 atom. In order to learn something about the byproducts formed during the labeling, some optically active compounds with hydroxyl groups, such as tartaric or malic acid, were labeled. It was found that in tartaric acid an OH group is replaced by tritium 60 times as fast as a carbon-bound H atom. In the case of malic acid there were 5 to 10 times as much tritium in succinic as in malic acid. By means of the fumarase reaction it was established to what extent configuration inversion is involved in the reaction that leads to malic acid. Via known enzyme reactions following tritium-labeled fructoses were prepared: the two fructoses-1-T stereospecifically marked at C-1, fructose-3,4,5-T, and fructose-3,5-T. Here again the tritium distribution was checked by means of degradation reactions. (auth)

43575 PREPARATION AND STORAGE OF TRITIATED AMINO ACIDS OF HIGH SPECIFIC ACTIVITY. Kl. Hempel (Universität, Cologne). p.1009-19 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Tritium-labeled amino acids of high specific activity (1000 mC/mmole and above) were synthesized for autoradiographic examination of the metabolism of proteins. Tritium was incorporated into suitable amino acid precursors in a specially designed apparatus by two different methods. Firstly, unsaturated compounds were reduced catalytically with tritium, and secondly, iodine and bromine derivatives of aromatic amino acids were dehalogenated catalytically with tritium. By means of these two methods it was possible to label virtually all the amino acids present in proteins. The radiochemical yield fluctuated considerably for the various syntheses, although the chemical yield of amino acid was always 80 to 100%. The radiochemical yield was partly dependent on the solvent, the catalyst used in the reaction, the position of the double bond in the molecule, and the resistance of the incorporated tritium to subsequent exchange for inactive hydrogen. The storability of tritiated amino acids of high specific activity was examined. Labeled amino acids were stored as solution and as solid form under various conditions and the radiochemical purity was measured as a function of the storage time. Tritiated amino acids of high specific activity were preserved best in 80% ethanol at −15°C. The radioactive impurities caused during storage were isolated and identified in individual cases. (auth)

43576 THE USE OF DOUBLE INTERMOLECULAR LABELLING IN HAEMOGLOBIN METABOLISM STUDIES. P. Padieu, N. Maleknia, and G. Schapira (Hôpital des Enfants Malades, Paris). p.1021-8 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

The biosynthesis of polypeptide chains of hemoglobin was initiated at the N-terminal and followed by sequential addition of amino acids until the C-terminal was reached (Dintzis method). Exact knowledge of the place of the different L-tyrosyl residues in each polypeptide chain allowed the uniformity of the rate of this sequential growth along the chains to be shown. (auth)

43577 SYNTHESIS OF ^{14}C-LABELED CURARIZING AGENTS. G. Milhaud and J. P. Aubert (Institut Pasteur, Paris). p.1031-4 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

The labeling of a number of curarizing agents permitted studies of their in vivo distribution and on the mechanism of curarization. Gallamine triiodoethylate-^{14}C and d-isochondodendrine diiodomethylate ^{14}C dimethylether were prepared. These compounds were used by Chagas et al. to study the mode of action of curare. The labeling of the two compounds was stable and enables the fate of the intact molecules in the body to be followed. (auth)

43578 HYDROGENOLYSIS OF TRITIUM-MARKED PHENOLS: PREPARATION OF TRITIUM-MARKED THYRONINES. J. Roche, J. Nunez, Cl. Jacquemin, and J. Pommier (College de France, Paris). p.1035-41 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

A method of catalytic hydrogenolysis of iodated phenols by tritium, whereby organic compounds of biological interest can be labeled on specific positions is described. The method consists of four stages: preparation of the appropriate basic material, setting-up and hydrogenolysis, purification and measurement of the specific activity of the substances obtained, and testing radiochemical stability. The catalytic hydrogenolysis method employs a set-up that allows easy manipulation, recovery of the excess gas, and total tritium labeling. When the substances obtained are tritium-labeled thyronines they are purified by chromatography. The radiodecompositions observed among strongly labeled substances depended on the nature of the compound studied and on the storage solvent. The radiodecomposition products were the same as those that result from cellular metabolism. This method enabled preparation of the analogs of the following thyroid hormones: thyronine, thyroacetic acid, tyrosine, 3-iodothyronine, 3-3′-diiodothyronine, 3-3′,5′-triiodothyronine, 3′-iodothyronine, and 3′-5′-diiodothyronine. Various other combinations on labeled positions are possible. Studies are under way for extending the method to the preparation of ^{3}H, 16-steroids tritium-labeled on this position from bromided basic materials (oestrone 16^{3}H, for example), and of peptides tritium-labeled on tyrosine residue from the corresponding iodopeptides. (auth)

43579 THE SYNTHESIS OF TRITIUM-LABELLED DL-CARNITINE AND CROTON BETAINE. W. G. Verly, P. A. Flamee, and Ch. J. Fallais (Université, Liège). p.1043-7 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Tritium labeling of dl-carnitine and croton betaine outside their methyl groups is described. The method consists in exposing β-hydroxy-γ-amino-butyric acid to tritium-labeled hydrogen by the Wilzbach process and subsequently methylating it in dl-carnitine, which is purified first by chromatography and continuous electrophoresis. Part of the tritium-labeled dl-carnitine is dehydrated to croton betaine, which in turn is purified by chromatography. During these operations, the carnitine and croton betaine are determined with permanganate, their purity checked by electrophoresis on paper, and their radioactivity measured by liquid scintillation. With these methods it was possible to obtain accurate information concerning the radiochemical purity of the synthesis products and also to assess the value of Wilzbach's exchange method for tritium labeling of the carnitine precursor, β-hydroxy-γ-amino-butyric acid. (auth)

43580 SYNTHESIS OF METHYL THYMINE-^{14}C AND METHYL THYMIDINE-^{14}C. G. Bignardi, W. Boeykens, and L. Carpentero (Centre d'Etude de l'Energie Nucléaire, Mol, Belg.). p.1049-57 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

A method of synthesis for methyl thymine-^{14}C and methyl thymidine-^{14}C was developed. It is based on the reduction of the Mannich base obtained by a reaction between uracil, labeled formaldehyde, and morpholine. The reduction results in the formation of thymine methyl-^{14}C with good yield. Thymidine methyl-^{14}C is prepared by means of an enzymatic reaction starting from active thymine. Purification of the products is performed by crystallization for thymine and by paper chromatography with two different eluent systems for thymidine. Radiochemical purity of both components is determined by radiochromatography while control of chemical purity and dosimetry are achieved by ultraviolet spectrophotometry. Other attempts to prepare thymine methyl-^{14}C by the same synthesis did not give the same results. (auth)

43581 BIOSYNTHETIC PREPARATION OF TISSUE LIPIDS AND STEROLS FROM LABELLED PRECURSORS. R. Fumagalli and R. Paoletti (Università, Milan). p.1071-82 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

The steps for cholesterol biosynthesis in mammalian tissues, starting from labeled precursors, such as acetate and mevalonic acid, are described. The use of different drugs and experimental conditions allows induction of an accumulation of some labeled precursors, which can be extracted and obtained in a pure form. The advantages of this biosynthetic approach for obtaining labeled complex molecules are discussed. (auth)

43582 BIOSYNTHETIC LABELLING OF HEN EGG PROTEINS. A. G. Schnek (Université Libre, Brussels); J. Leonis, L. Ledoux, and M. Rappaport. p.1083-93 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

In vivo labeling of egg white proteins was accomplished, using different types of markers. The highest incorporation yield was reached with specific precursors, such as the following amino acids: tyrosine, tryptophan, arginine, and lysine (all labeled with tritium). Depending on the protein and on the precursor, the main egg-white constituents could be obtained with specific activities ranging from 1 to 100 mC/mmole, i.e., approximately μC/mg. Kinetic studies of the incorporation process revealed a complete similarity between all the proteins of the egg white; a sharp radioactivity maximum was always observed at the second egg after injection. Further, these kinetic studies made it likely that the label remains located in the very amino acid used as precursor. Experiments using two precursors simultaneously, one labeled with ^{32}P and one with ^{3}H, disclosed a further radioactivity maximum around the sixth egg after injection; this indicated that several mechanisms operate during the biosynthesis of egg-white proteins. In the case of the egg-yolk proteins, two amino acids were chiefly investigated (arginine and lysine). Their rate of incorporation was found to be much lower than for the egg-white constituents, and also lower for the water-soluble yolk proteins than for the insoluble ones. When individual proteins were studied separately, each was observed to have a specific rate of biosynthesis; therefore, the biogenetic pathways appeared of greater complexity for the yolk than for the white. This view was further substantiated by investigations of the incorporation of a tritiated amino acid, a ^{32}P-labeled precursor, and a mixture of both. (auth)

43583 BIOSYNTHESIS OF ^{14}C LABELLED GIBBERELLIC ACID. B. Parisi, G. Lucchini, and E. Marrè (Università, Milan). p.1095-1104 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

It was previously known that the maximal rate of production of gibberellic acid by Fusarium moniliforme occurs when fungal growth declines because of exhaustion of organic substrates in the medium. It was observed that a good rate of gibberellic acid synthesis can also be induced by transferring the rapidly growing mycelium from a rich organic medium into an inorganic medium. In a short period after the substitution of the medium, micromolar amounts of labeled organic substrates (glucose, sucrose, glycerol, etc.), when fed, are rapidly taken up by the fungal cells and radioactivity is efficiently incorporated in the various metabolites. This behavior was made use of to economically prepare ^{14}C-labeled gibberellic acid. The growing mycelium of Fusarium was transferred, after rapid washing, from a rich medium (Darken containing 2% glycerol) to a completely inorganic one, to which glucose-^{14}C (45 mC/mmole) was added gradually during a period of 36 hr, using a device such to maintain the glucose concentration close to 2×10^{-4}M. At the end of this period, the gibberellic acid produced was extracted, crystallized according to a modification of the Curtis and Cross method, and further purified by chromatography. The yield in purified gibberellin A_3 was of about 0.6 mg/g of mycelium with a recovery of about 1% of the total radioactivity fed. The specific activity obtained was of about 1.0 mC/mmole of purified gibberellic acid. It appeared that this procedure could be utilized to obtain isotopic labeling of various metabolities of biological interest produced by fungal or bacterial cultures. (auth)

43584 THE PREPARATION OF ^{35}S-LABELLED BIOLOGICAL DERIVATIVES OF HIGH SPECIFIC ACTIVITY (METHIONINE, TAURINE, CYSTEIC ACID, ISETHIONIC ACID, ETC.) E. Schram, M. Cape-Goldfinger, and Th. Mayer (Université Libre, Brussels). p.1105-13 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

A series of substances labeled with ^{35}S were prepared. The chromatographic methods worked out allow the preparation of these substances in appropriate amounts when needed, with specific activities in the order of 1000 mC/mmole. The radiochromatographic purity of any given preparation is checked before use. As a starting material E. coli cultured in a mineral medium containing carrier-free ^{35}S-sulfate was used. Methionine was obtained by acid hydrolysis of the culture centrifugate in the presence of $SnCl_2$, and by subsequent chromatography on ion exchangers in the presence of thiodiglycol. Cysteic acid was obtained by previous performic oxidation. The enzymatic decarboxylation of cysteic acid with a liver homogenate (previously dialyzed in order to eliminate pre-existing taurine) yielded taurine, which may, in turn, be converted to isethionic acid with nitrous acid. All techniques described are applicable to very small amounts of material and high specific activities are attained. The labeled substances were stored as solutions in the frozen state. (auth)

43585 PREPARATION AND THIN-LAYER CHROMATOGRAPHY OF 1, 2, 4-^{3}H-DEXAMETHASONE. D. Jerchel, S. Henke, and Kl. Thomas (Chemisch-pharmazeutischen Fabrik Dr. Karl Thomae GmbH, Biberach, Riss, Ger.). p.1115-22 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

By hydrogenation of dexamethasone-21-acetate with palladium-animal charcoal as catalyzer using a tritium-hydrogen mixture the steroid labeled 1,2,4,5-^{3}H was ob-

tained. SeO_2-dehydrogenation in purest pyridine resulted in a mixture of substances, containing the acetate of the tritiated dexamethasone. The best process of purification was thin-layer chromatography. In this way the chemically and radiochemically pure 1,2,4-^{3}H-dexamethasone was obtained. The radiochemical purity was proved on the thin-layer plate with a measuring instrument employing a windowless methane scanner. (auth)

43586 PREPARATION, PROPERTIES AND STORAGE OF NUCLEIC ACIDS. L. Ledoux, C. Davila, R. Huart, and P. Charles (Centre d'Etude de l'Energie Nucléaire, Mol, Belg.). p.1123-31 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

A method was developed for the chromatographic fractionation of ribonucleic and desoxyribonucleic acids on cellulose paper (strips or centrifuged pulp). In the case of DNA, specific chromatographic profiles were obtained on strips for quantities of about one microgram. Six to twelve fractions can thus be easily separated in a very short space of time. Because of the ease and reproducibility of the method, a large number of samples can be analyzed at the same time. By means of this method, various separation techniques now being used in the biochemistry of nucleic acids were studied, together with the effects of ageing, denaturing due to heat, enzymatic hydrolysis, and ultrasound. About thirty different nucleic acid preparations labeled with ^{14}C and/or ^{3}H were made from various starting materials. By the use of bacteria mutants, nucleic acids having a very high specific activity were obtained and their spontaneous radiolysis is being studied. (auth)

43587 PREPARATION OF HIGH-SPECIFIC-ACTIVITY TRITIATED THYMINE AND THYMIDINE. M. Winand and L. Gouverneur (Centre d'Etude de l'Energie Nucléaire, Mol, Belg.). p.1147-55 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

A method was developed for the preparation of tritiated thymidine and thymine with high specific radioactivity, in which the atoms of tritium hold specific and stable positions. Thymine was labeled exclusively in the methyl group by reducing 5-chloromethyluracil with tritium. Thymidine-^{3}H was obtained by trandesoxyribosidation between deoxyuridine and thymine methyl-^{3}H. The extemporaneous preparation of the catalytic desoxyribose-transferring enzyme from rat liver ensured great reproducibility of the method. Purifications of the tritiated thymine and thymidine were effected by paper chromatography, and the systems used allowed for treatment of quantities in the order of 100 μmole at a time. The chemical purity was determined by uv spectrometry and the radioactive purity by paper chromatography in various systems. (auth)

43588 CLOSED SYSTEM SYNTHESIS OF ^{14}C-LABELLED α-KETOACIDS WITH HIGH SPECIFIC ACTIVITY. D. Bella (Centro Internationale di Chimica Microbiologica, Rome). p.1161-70 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

A method is described for the microscale (0.2 mmole) preparation of α-keto acids without dilution. Phthaloyl chloride was reacted with an alkali salt of a carboxylic acid to obtain the acid chloride, which was then converted with cuprous cyanide to the α-ketonitrile. The latter was treated with anhydrous HCl in ether to yield the imidochloride; this was then hydrolyzed to the amide, which was finally converted to the corresponding acid through a cation-exchange-resin-catalyzed hydrolysis. By the use of a closed system (vacuum line) it was possible to obtain good overall yields (approximately 50%) of high-activity α keto acids. The preparation of pyruvic acid as examined and a description of the various units of apparatus is given. (auth)

43589 SYNTHESIS OF VARIOUS ^{3}H-LABELED RADIOISOMERS OF SALICYLIC ACID. R. Michel and R. Truchot (Ecole de Medecine et de Pharmacie, Dijon, France). p.1171-6 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Diazotization of 4-aminosalicylic acid was followed by conversion into 4-iodosalicylic acid by decomposition of the diazotated substance by iodine; 3- and 3.5-iodosalicylic acids were prepared by direct halogenation. The various iodated substances were subjected to up to 75% catalytic diiodation by ^{3}H in the presence of Raney nickel. The tritium-labeled isomers were then isolated after extraction in ether and purified chromatographically. (auth)

43590 SYNTHESIS OF TRITIATED STEROIDS. P. A. Osinski (Université Catholique, Louvain, Belg. and Universitaires St-Pierre, Louvain, Belg.). p.1177-84 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Different methods of synthesis of tritiated steroids are reviewed: catalytic reduction of double bonds, catalytic dehalogenation of bromo-derivatives, and biosynthesis from tritiated precursors. The advantages and limitations of these methods are discussed and compared with the Wilzbach tritium exposure method. Results from the combined use of chemical and biosynthetic methods for the preparation of tetrahydro metabolites of the principal adrenal steroids are reported. (auth)

43591 METHODS OF DESULPHURIZING AND DEHALOGENATING HYDROGENOLYSIS OF ORGANIC MOLECULES, AS APPLIED TO THE SYNTHESIS OF DEUTERATED AND TRITIATED COMPOUNDS. N. P. Buu-Hoie, N. Dat Xuong, and N. Van Bac (Centre National de la Recherche Scientifique, Gif-sur-Yvette, France and Office National de l'Energie Atomique du Vietnam, Saigon). p.1237-44 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Raney alloys (nickel and cobalt) used in alkali medium for desulfurizing or dehalogenating hydrogenolysis of organic molecules bearing acid functions may provide an easy route of access to organic substances rich in deuterium or tritium, in whose molecule the atoms of the hydrogen isotopes occupy sites that in most instances are predictable. These syntheses are effected by means of deuterium oxide or tritium oxide, which gives them a definite advantage over other labeling techniques. In the case of non-acid molecules, the desulfurizations and dehalogenations are effected with Raney nickel or cobalt prepared with deuterium oxide or tritium oxide, in the presence of aprotic solvents whose protons do not easily undergo exchange. Several examples of these syntheses are given, and some limitations pointed out. (auth)

43592 SYNTHESIS OF PERYLENE-13, 14-^{14}C. L. Pichat, Ch. Baret, and A. Bague (CEN, Saclay, Gif-sur-Yvette, France). p.1251-62 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

The following scheme was adopted for the synthesis. Carbonation of 3-phenylpropylmagnesium bromide by $^{14}CO_2$ give 4-phenylbutyric acid carboxyl-^{14}C with a yield of 85%. Cyclization by polyphosphoric acid led to α-tetralone-1-^{14}C (yield = 85%), which when reduced by amalgamated

aluminum gave rise to a glycol that dehydrated gives tetrahydrobinaphtyl. Dehydrogenation of the latter by sulfur provided 1-1′-binaphtyl-1-1′-^{14}C with a yield of 50%. Perylene-^{14}C was purified by chromatography over alumina (columns of large sizes). Overall yield based on $Ba^{14}CO_3$ was about 4 to 5%. Perylene was radiochromatographically pure; its specific activity was 28.6 mC/mmole and ultraviolet spectrum in accordance with literature. It was stored at −35°C in toluene solution. (auth)

43593 SYNTHESIS OF CERTAIN DEUTERATED COMPOUNDS WITH HIGH ISOTOPE RATIO. B. Chenon (Laboratoiire de Recherches de Spectrochimie, Moleculaire, Paris); P. Dizabo, A. Gruger, and L. C. Leitch. p.1263-9 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

The synthesis of deuterated compounds was carried out by three different methods. Dimethylnaphthalenes were prepared by condensation of methyl-D_3-bromide and naphthyl lithium compounds prepared from different dibromo-compounds by the modified method of Gilman and Moore. Reductive dehalogenation was used for the preparation of aryl methanes. The reduction medium consisted of a mixture of zinc powder and deuterated acetic acid. The temperature of the reaction varies according to the reactions from −40°C for $(C_6H_5)_2CD_2$ to +20°C for $C_6H_5CH_2D$. The molar isotopic yields were: $C_6H_5CH_2D$, 98.4%; $(C_6H_5)_2CHD$, 97%; and $(C_6H_5)_2CD_2$, 95.1%. Four monodeuterated isomers of phenanthrene were prepared by a reductive dehalogenation in basic medium. The reduction was carried out at 100°C in presence of zinc and $Ca(OD)_2$ in heavy water. The dehalogenation was complete. The isotopic content was above 97% in every case. (auth)

43594 SYNTHESIS OF PHENOBARBITAL (ETHYL-5 PHENYL-5 BARBITURIC ACID) 2-^{14}C AND 5-^{14}C. A. Benakis (Universite, Geneva). p.1283-92 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

For study of its metabolism in live organisms, phenobarbital labeled in position 2 of the pyrimidinic cycle was synthesized. This labeling was performed by condensation of ethylphenylethylmalonate with urea-^{14}C. The specific activity of the product was 0.1 mC/mmole. In order to pursue research in the metabolism of this product it was necessary to prepare phenobarbital labeled in position 5 of the pyrimidinic cycle. This synthesis consists of 7 steps and has ^{14}C-benzoic acid as an initial product. These various stages are: synthesis of benzylic alcohol-7-^{14}C, benzyle chloride-7-^{14}C, benzyle cyanide-7-^{14}C, ethylphenylacetate-2-^{14}C, ethylphenylmalonate-2-^{14}C, ethylethylphenylmalonate-2-^{14}C, and ethyl-5-phenyl-5-barbituric acid-5-^{14}C. Specific activity of this product was 11 mC/mmole. Methods, yields, specific activities obtained, and radiochemical purity are discussed. (auth)

43595 A CONTRIBUTION TO THE STUDY OF THIAZOLE RING GEOMETRY. H. A. Braun and J. Metzger (Laboratoire de Chimie Organique, Marseille). p.1295-1302 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

The geometrical structure of molecules can be determined by various methods. One of these, microwave spectroscopy, needs the synthesis of isotopically labeled compounds to determine the parameters of the structure. In the case of the thiazole cycle there are seven distances and six angles. These parameters can be determined by studying the rotational spectrum of labeled compounds. Each independent isotopic compound furnishes two constants. Therefore it was necessary to prepare seven isotopically labeled molecules. The synthesis of the following thiazoles are described: thiazole-^{15}N, thiazole-$^{13}C_2$, thiazole-D_2, thiazole-$^{13}C_5$, thiazole-D_4, thiazole-$^{13}C_4$, thiazole-D_5, and thiazole-$^{13}C_5$. (auth)

43596 PREPARATION OF CERTAIN OXYGEN-MARKED COMPOUNDS. H. Dahn (Université, Lausanne, Switzerland). p.1303-8 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

The starting material for all tracer work with oxygen isotopes is water ($H_2{}^{18}O$ or $H_2{}^{17}O$). Often, ^{18}O can be used in low abundance (0.5 to 5 at. %); in work with more highly enriched ^{18}O or with ^{17}O (enriched to 0.5 to 2 at. %) it is important, for economic reasons, to recover the excess reaction water. Oxygen exchange processes between organic substrates and water often offer a convenient route of labeling, on the other hand, undesirable exchange processes occurring during extraction may cause a loss of tracer. CO_2 easily exchanges oxygen with H_2O^*. $CO_2{}^*$ may react with R-Mg-X to form carboxylic acids, R-CO*O*H. Acids can also be labeled by the reaction of R-COCl with H_2O^*, but this yields only 50% label. A third method of preparing labeled acids is exchange between R-COOH and H_2O^* at high temperature and rather long reaction time. Aldehydes and ketones exchange their oxygen with that of H_2O^*, presumably via hydrate formation. With other carbonyl compounds, oxygen exchange is of limited usefulness; e.g., labeled esters and amides have to be prepared from labeled acids. Labeled primary alcohols are obtained by reduction of acid derivatives, secondary and tertiary alcohols by the Grignard reaction. Examples of these reactions are discussed. (auth)

43597 STEREOSPECIFIC DEUTERATION OF STEROIDAL ALCOHOLS. J. Levisalles and J. P. Pete (Université, Strasbourg). p.1313-18 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Preparation of the four possible epimers of 2-deutero-4;4-dimethyl(5α)-cholestane-3-ol by stereospecific methods is described. $LiAlD_4$ reduction of 2,3α-epoxy-4;4-dimethyl(5α)-cholestane gave 2β-deutero-4;4-dimethyl(5α)-cholestane-3α-ol. Under mild conditions, this was oxidized to the corresponding ketone. $LiAlH_4$ reduction of the ketone gave 2β-deutero-4;4-dimethyl(5α)-cholestane-3β-ol. $LiAlD_4$ reduction of 2,3β-epoxy-4;4-dimethyl(5α)-cholestane led to 2α-deutero-4;4-dimethyl(5α)-cholestane-3β-ol. NaOD deuteration of 4;4-dimethyl(5α)-cholestane-3-one gave 2;2-dideutero-4;4-dimethyl(5α)-cholestane-3-one, which was reduced by $LiAlH_4$ to 2;2-dideutero-4;4-dimethyl(5α)-cholestane-3β-ol. The corresponding benzoate was pyrolyzed to 2-deutero-4;4-dimethyl(5α)-cholest-2-ene. Peracid oxidation of the latter gave 2β-deutero-2,3α-epoxy-4;4-dimethyl(5α)-cholestane, which was reduced by $LiAlH_4$ to 2α-deutero-4;4-dimethyl(5α)-cholestane-3α-ol. (auth)

43598 SOME DIFFICULTIES ENCOUNTERED IN THE PREPARATION OF DEUTERATED ORGANIC MOLECULES OF HIGH ISOTOPIC PURITY. R. Viallard (Laboratoire de Chimie Physique, Faculté des Sciences, Paris). p.1323-7 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Criteria governing selection of methods used in the preparation of deuterio-substituted compounds are discussed. Several difficulties encountered in the prepara-

tion of isotopic compounds containing both hydrogen and deuterium are outlined. (M.C.G.)

Radiation Chemistry and Radiochemistry

Refer also to abstract 44004.

43599 (AERE-R-4658) THE RADIOLYTIC REACTION BETWEEN GRAPHITE AND CARBON DIOXIDE: GAS FLOW EXPERIMENTS. PART I. EFFECTS OF SPECIMEN CONTAINMENT, RADIOACTIVE IMPURITIES AND CARBON MONOXIDE. F. S. Feates, R. S. Sach, and F. A. Walker (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England). June 1964. 38p.

Equipment for passing carbon dioxide over ^{14}C-labeled graphite in the nuclear reactors BEPO and DIDO is described. Containment of the graphite in silica or stainless steel vessels is shown to have negligible effects on the form of the results. The addition of carbon monoxide to carbon dioxide reduced the ^{14}C activity of the gases leaving the graphite at pressures of 16.7 and 20 atmospheres by a factor of about 3. Spurious activities resulting from the neutron activation of impurities in the gas and specimen have been detected and identified. (auth)

43600 (IA-843) GAS CHROMATOGRAPHIC SEPARATION OF P^{32} PRODUCED BY NEUTRON IRRADIATION OF SULPHUR. J. Tadmor (Israel. Atomic Energy Commission. Soreq Research Establishment, Rehovoth). May 1964. 14p.

The gas chromatographic separation of ^{32}P from neutron-irradiated sulphur compounds was investigated. The carrier-free radioisotope was separated in a short time from minute amounts of neutron-irradiated sulphur compounds, with good recovery yields. The repartition of ^{32}P and ^{35}S activity in the different phosphorus and sulphur species formed in the irradiation, was determined. (auth)

43601 (TID-21007) NUCLEAR CHEMISTRY AND GEOCHEMISTRY RESEARCH PROGRESS REPORT, 1963–1964. (Carnegie Inst. of Tech., Pittsburgh). July 31, 1964. Contract AT(30-1)-844. 51p.

Irradiation by 6.1-Bev protons of an Fe stack consisting of Ni, Fe, Al, Mg, and polyethylene sheets located between Fe absorbers is reported. The partial effective cross sections of these reactions measured in circular zones are tabulated. Another stack consisting of Pb, Ag, Fe, stainless steel, Si, Glass, Al, Mg, and polymeric materials was irradiated by 100-Mev protons. Data from this experiment are tabulated and should be useful in estimation of solar flare proton parameters. Other work is reported on formation cross sections of various radionuclides from Ni, Fe, Si, O, and C for protons at 0.5 to 3.0 Bev. A plan for measurement of the spallation cross sections of Li, Be, and B isotopes is outlined. Work toward analysis of thick-target bombardments for interpretive use in measurements of nuclear reaction products in meteorites is reported along with efforts devoted to dating of marine sediments by Th and Pa isotopes. Efforts in a search for cosmic-ray-induced activities in tektites are also reported. Results of analysis of stone meteorites for cosmogenic radionuclides are reported along with results of depth studies of cosmogenic radionuclides in Fe meteorites. A review of observations on muon-induced radioactivity in nature and plans for further research in the use of such reactions in estimating exposure ages of natural materials are outlined. The use of ^{129}I in geochronology is discussed along with self-absorption of ^{26}Al positrons in alumina and Mössbauer studies of Fe in natural materials. (J.R.D.)

43602 THE MÖSSBAUER EFFECT AND ITS APPLICATION IN CHEMISTRY. E. Fluck (Universität, Heidelberg). Advan. Inorg. Chem. Radiochem., 6: 433-89(1964).

The Mössbauer effect and its significance in chemistry are discussed. The theory of resonance fluorescence and properties of nuclear resonance fluorescence are outlined. Physical and chemical applications of this effect are described. (M.C.G.)

43603 RADIATION-INDUCED CHANGES IN REACTIVITY OF AMMONIUM PERCHLORATE. E. S. Freeman (Illinois Inst. of Tech., Chicago) and D. A. Anderson. Am. Soc. Testing Mater., Spec. Tech. Publ., 359(1963), 58-70 (1964).

Exposure to x and gamma radiation profoundly alters the thermal stability and decomposition characteristics of ammonium perchlorate in the solid state. The radioinduced changes in chemical reactivity were revealed by investigations involving thermogravimetric experiments and differential thermal analysis, where temperature is increased continuously at a constant rate, isothermal rate studies as a function of temperature, hot stage microscopic and x-ray diffraction studies, and electron spin resonance. Both a review and evaluation of recent investigations and new experimental results and interpretations of the reaction mechanisms are presented. (auth)

43604 RADIATION-INDUCED DECOMPOSITION OF INORGANIC SOLIDS. E. R. Johnson (Atomic Energy Commission, Washington, D. C.). Am. Soc. Testing Mater., Spec. Tech. Publ., 359(1963), 71-8(1964).

Factors governing the radiolytic decomposition of inorganic solids are discussed. A general review of the radiolysis of the inorganic nitrates is presented to show that free space is not an important parameter when discussing relative G-values. (auth)

43605 CONTRIBUTION TO THE STUDY OF ORGANIC SCINTILLATORS IN SOLUTION. Margareta Tibu, Candiano Leonte, and I. Viscrian. Analele Stiint. Univ. "A. I. Cuza" Iasi Sect. I, 8, No. 1, 173-80(1962). (In Romanian)

After a brief review on the principle of the function of the scintillation counter and the mechanism of the energy transfer of solvent molecules to the dissolved substance, the results of studies on the characteristics of three scintillators: p-bis-2-(5-phenyloxazolyl)-benzene (POPOP), 1,1',4,4-tetraphenylbutadiene-1,3, and 2-phenyl-indolysine for adaption in the FEU-29 photomultiplier are given. Preparation of the compounds and the installation of the measuring device are described, and the curves of variation of the counting rate for different tensions of discrimination and total current of the photomultiplier anode are given as a function of the concentration of the scintillators in toluene. It was concluded that POPOP can be used as a shifter for the FEU-29 photomultiplier. (P.C.H.)

43606 RADIOCHEMICAL HYDROXYLATION OF PHENOLIC COMPOUNDS. F. Merger and D. Graesslin (Universitat, Heidelberg). Angew. Chem. Intern. Ed. Engl., 3: 640(Sept. 1964).

Studies on the radioinduced hydroxylation of phenolic compounds are reported. Irradiation of a 1% aqueous solution of gallic acid saturated with oxygen (dosage rate of the

^{60}Co γ source: 4.06×10^5 R/hr; irradiation time: 300 hr) gave 2,3,4,5-tetrahydroxybenzoic acid in 52.8% yield with a G-value of 0.22; separation of the residual gallic acid was achieved by fractional crystallization and preparative chromatography. The G-values for some other phenolic carboxylic acids were considerably higher. Nitrophenols were hydroxylated much faster than phenolic carboxylic acids. p-Nitrophenol affords 4-nitrocatechol, and 4- or 5-nitropyrogallol give the hitherto unknown 1,2,3,4-tetrahydroxynitrobenzene (G = 1.41). (P.C.H.)

43607 5,12-DIPHENYL-7-OXYL-DINAPHTHO[1,2-b:2′,3′-d]FURAN AS RADICAL CAPTOR IN γ RADIOLYSIS OF ORGANIC SOLVENTS. Dietrich Schulte-Frohlinde and Friedrich Erhardt (Kernforschungszentrum, Karlsruhe, Ger.). Ann. Chem., 671: 88-92(1964). (In German)

The radical captor properties of the oxygen radical 5,12-diphenyl-7-oxyl-dinaphtho[1,2-B:2′3′-d]furan (called dinaphthofuranoxyl) was compared with those of the nitrogen radical α,α-diphenylpicrylhydrazyl (DPPH). A ^{60}Co source was used for the irradiation of the organic solvents. The G value for the decoloration of dinaphthofuranoxyl and DPPH in various solvents are tabulated. Similar values were obtained for both radicals. (J.S.R.)

43608 THE ROLE OF DIFFUSION CURRENT IN THE ELECTROLUMINESCENCE OF GaAs DIODES. M. F. Millea and L. W. Aukerman (Aerospace Corp., El Segundo, Calif.). Appl. Phys. Letters, 5: 168-9(Oct. 15, 1964).

Observations on the intensity of the principal emission band (~1.37 ev at 298°K) and radiation damage effects in GaAs diodes are discussed. The intensity and current as a function of voltage for a typical diode before and after exposure to an integral flux of 3.2×10^{15}/cm 2-Mev electrons are shown. It is concluded that when diffusion current dominates the total current the intensity at a given current is decreased approximately as $\Phi^{-\frac{1}{2}}$. (C.E.S.)

43609 PROTON-TRANSFER EFFECTS IN THE QUENCHING OF FLUORESCENCE OF TYROSINE COPOLYMERS. G. Weber (Univ. of Illinois, Urbana) and K. Rosenheck. Biopolymers Symp., No. 1, 333-41(1964).

Copolymers of a few per cent of tyrosine with glutamic acid, with lysine, and with glutamic acid and lysine show at neutral pH low quantum yields of fluorescence (0.02 to 0.05) of the same order of those found in tyrosine containing proteins. A study of the pH dependence of the fluorescence yield shows that among several processes of internal conversion, the transfer of a proton from the excited phenolic ring to the COO^- or $-NH_2$ groups plays a dominant part. A comparison of the quantum yield of the copolymers before and after O-methylation of the tyrosine residues permits the conclusion that the rate of deactivation by proton transfer processes is four or five times faster than the total rate of deactivation by other processes of unknown origin. (auth)

43610 THERMOLUMINESCENCE OF AMINO ACIDS AND PROTEINS IRRADIATED WITH ULTRAVIOLET LIGHT. J. E. Gill and M. Weissbluth (Stanford Univ., Calif.). Biopolymers Symp., No. 1, 433-9(1964).

Aromatic amino acids and certain iron-free proteins emit thermoluminescence after being irradiated with ultraviolet light at 77°K. Glow curves from the amino acids can be fit with curves derived on the basis of a monomolecular model in which the molecules absorb, hold and reemit energy independently. In terms of this model, the activation energy for thermoluminescence emission from L-tyrosine is 0.16 ev. Protein thermoluminescence appears to have a smaller activation energy and not to follow monomolecular kinetics. The thermoluminescence from L-tyrosine can be optically quenched. (auth)

43611 MEASUREMENT OF ELECTRON SPIN RESONANCE DIFFERENCE SPECTRA AT 77°K. APPLICATIONS OF THE METHOD IN LOW-TEMPERATURE RADIATION CHEMISTRY. D. R. Smith and J. J. Pieroni (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Chem., 42: 2209-14(Oct. 1964).

The technique of measuring ESR difference spectra was extended to 77°K. This enables elimination of the main signal due to irradiated silica sample tubes and of about 90% of the hydrogen atom signal from the same source. When the ESR spectrum due to one species can be photochemically bleached, the method permits resolution of two superimposed spectra. This was demonstrated by measurements which resolve the ESR singlet due to trapped electrons in irradiated tetrahydro-2-methylfuran from the underlying septet. These developments have rendered the ESR difference method very useful for the study of paramagnetic species formed in systems which have been gamma-irradiated at 77°K. (auth)

43612 ELECTRON SPIN RESONANCE OF PEROXY RADICALS IN GAMMA-IRRADIATED POLYTETRAFLUOROETHYLENE. Hazime Tanaka, Akira Matsumoto, and Nobuhisa Goto (Central Research Lab., Tokyo). Bull. Chem. Soc. Japan, 37: 1128-33(Aug. 1964).

Peroxy radicals in gamma irradiated polytetrafluoroethylene (PTFE) were studied by ESR. The transition process from the spectrum observed in vacuo to the spectrum that is obtained in a specimen aged in air, considering two sorts of peroxy radicals, and also the stability of the peroxy radicals under heat treatment were investigated. The nature of the peroxy radicals is discussed in the light of data on the orientation dependence of their ESR spectra and the crystalline arrangement of PTFE. In the oriented sample of irradiated PTFE, the ESR spectrum of peroxy radicals consists of two singlets. One of them has an angular dependent g factor: $g = 2.0230 - 0.0165 \cos^2\omega$, where ω is an angle between the orientation of the PTFE crystal and the direction of the magnetic field applied. This spectrum shows an asymmetrical profile in a powder sample. Additional peroxy radical, which gives an angle-independent ESR signal, is unstable at temperatures above 150°C. (P.C.H.)

43613 THE THERMAL AND RADIATION OXIDATION OF BENZENE TO PHENOL IN AQUEOUS SOLUTIONS CONTAINING METAL IONS AT ELEVATED TEMPERATURES. VI. THE BY-PRODUCTS OF BENZENE OXIDATION. Hiroshi Hotta, Nobutake Suzuki, Nobue Itatani, and Kazuo Shimada (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 37: 1147-8(Aug. 1964).

The by-products of benzene oxidation were analyzed and compared with those of phenol oxidation. Unpurified benzene was oxidized thermally in aqueous solutions of 0.01M ferrous and cupric sulfates, while purified benzene was oxidized with gamma irradiation in the same solutions. The amounts of acetic acid produced increased with the rise in temperature, even at 220°C, at which point the amount of phenol did not increase so much. The amounts of acetaldehyde produced did not increase at temperatures higher than 200°C, as in the case of phenol. The products found in the decomposition of phenol were also detected. Formaldehyde and acetone were found to be in the greatest quantity by about 1.5×10^{-6} mole at 200°C. It was concluded that the phenol produced is violently decomposed to acetic acid

through acetaldehyde at high temperatures. That is, the saturation of the phenol yield at elevated temperatures is neither due to the self-inhibition effect of phenols on the oxidation reactions nor to some termination and competing reactions with the chain-carrying radicals. (P.C.H.)

43614 ELECTRON SPIN RESONANCE STUDIES OF DEUTERATED BORATE GLASSES IRRADIATED WITH GAMMA RAYS AT LIQUID NITROGEN TEMPERATURE. Yasuo Nakai (Tokyo Shibaura Electric Co.). Bull. Chem. Soc. Japan, 37: 1237(Aug. 1964).

Borate glass, B_2O_3, was deuterated for the purpose of examining the effect of water or B–O–H–O–B in glass. The sample was then irradiated at liquid nitrogen temperature with ^{60}Co gamma rays (1×10^6 R). H and D resonances were found to arise from the hydrogen atom center, H^0 of interstitial vacancy produced by the radiolysis of B–O–H–O–B or H_2O in glass. At room temperature, hydrogen atoms may diffuse to form hydrogen molecules or BOH. Thus, no paramagnetic resonance absorption due to H^0 and D^0 centers can be observed. (P.C.H.)

43615 HIGH-KINETIC ENERGY FRAGMENT IONS FROM ORGANIC COMPOUNDS UNDER ELECTRON IMPACT. IV. METHANOL. Toshikazu Tsuchiya (Government Chemical Industrial Research Inst., Tokyo). Bull. Chem. Soc. Japan, 37: 1308-10(Sept. 1964).

Fragment ions with high kinetic energies were produced from methanol by electron impact, as in the cases of many hydrocarbons. Assuming that a fragment has a rotational energy of the order of 0.5 ev most of the high-energy ions from methanol can be ascribed to a doubly charged molecule ion that dissociates into two singly charged fragments. (auth)

43616 THE EFFECT OF THE TYPE OF RADIATION ON THE RADIATION-INDUCED ADDITION OF ACETALDEHYDE TO CYCLOHEXENE. Akira Shingyouchi, Motoyoshi Hatada, and Kozo Hirota (Japanese Assn. for Radiation Research on Polymers, Osaka and Osaka Univ.). Bull. Chem. Soc. Japan, 37: 1320-4(Sept. 1964).

Several kinds of products were formed from mixtures of cyclohexene and acetaldehyde by the irradiation of γ rays, electron beams, and ultraviolet. Both the yields and the kind of product seem to depend on the type of radiation because of their dose rate and bond-dissociating power. (auth)

43617 THE SZILARD-CHALMERS REACTION OF SEVERAL NEUTRON-IRRADIATED INORGANIC PHOSPHORUS COMPOUNDS. Kichizo Tanaka (Japan Atomic Energy Research Inst., Tokyo). Bull. Chem. Soc. Japan, 37: 1346-52(Sept. 1964).

The distribution of the chemical species containing phosphorus-32 formed by the (n,γ) reaction was studied for several phosphates as functions of the irradiation conditions in a reactor. The variation in the distribution is discussed in connection with the radiation annealing process during irradiation, and a comparison of the distribution of the chemical species containing phosphorus-32 by three separation methods was made. By means of the analysis of the variation curves of the distribution of the chemical species containing phosphorus-32, the apparent rate constants were estimated. It is suggested that the variations in the distribution may be approximately expressed by radiation annealing processes, and that they are affected by pile factors. (auth)

43618 RADIOLYSIS OF n-BUTANE IN THE GAS, LIQUID AND SOLID PHASES. Tetsuo Miyazaki, Shigeyoshi Arai, Shoji Shida, and Shiro Sunohara (Tokyo Inst. of Tech. and Japanese Assn. for Radiation Research on Polymers, Tokyo). Bull. Chem. Soc. Japan, 37: 1352-5(Sept. 1964).

The phase effect in the radiolysis of n-butane was studied. A clear difference between the C–C bond scissions was found in the gas and condensed phases. The results indicate that fragmentation of the butane ion is important in the gas phase radiolysis, but that in the condensed phases the butane molecule is important. (P.C.H.)

43619 ELECTRON IRRADIATION OF HYDROCARBONS. I. RADIOLYSIS OF LIQUID n-PENTANE. P. Claes and S. Rzad (Université, Louvain, Belg.). Bull. Soc. Chim. Belges, 73: 689-702(July-Aug. 1964).

The effects of 30-kev electrons on liquid pentane were studied. The influence of dose rate and total dose absorbed by the irradiated system on the yields of gaseous products was investigated. The partition between gaseous and liquid phases is characterized by an equilibrium obeying Henry's law. An analytical method allowing the quantitative determination of these hydrocarbons was worked out. However, the difference between the various G values was not significant. It appears the dose rate does not influence the yields of different products formed during radiolysis. Data are tabulated. (P.C.H.)

43620 THE EFFECTS OF γ-RAY IRRADIATION ON THE ELECTRIC PROPERTIES OF MYLAR. Tatto Nakai and Takeshi Sakakibara. Denki Gakkai Zasshi, 83: 263-71 (Mar. 1963).

The effects of irradiation and heat treatment on electric properties were studied. Samples of Mylar capacitor (with or without heat treatment) and 25-μ thick Mylar film were irradiated by a 1000-C ^{60}Co source at 20°C in vacuum, air, or insulation oils at 1.2 to 4.0×10^5 r/hr. The variations in capacity, insulation resistance, volume resistivity, dielectric constant, dielectric loss tangent, dynamic modulus, and d-c breakdown field intensity are given as functions of the dosage rate, and are compared with those for polystyrene. It was found that: the different irradiation effect shown between the capacitor and film was due to heat treatment causing contraction that changed the contact between dielectric and electrode; the dielectric constant and dielectric loss tangent varied only slightly due to irradiation, while volume resistance increased with increasing radiation dosage; the d-c breakdown value is lowered by irradiation in air, but not in vacuum, while the impulse and a-c breakdown remained constant; and at about 10^8 r irradiation in air, a carboxyl radical was formed as the main chain was broken. The dynamic modulus increased and a light yellow color appeared with increasing dosage rate. (OID)

43621 INSULATION RESISTANCES IN POLYETHYLENE AND TEFLON UNDER γ-RAY AND ELECTRON BEAM IRRADIATION. Kichinosuke Yahagi, Kenichi Shinohara, and Kazuo Mori. Denki Gakkai Zasshi, 83: 292-300(Mar. 1963).

The recovery process of insulation resistance after irradiation cessation was studied. Polyethylene film (0.01-mm thick, 85-mm dia, 45% crystallinity) and Teflon film (0.5-mm thick, 85-mm dia, 35% crystallinity) were chosen as examples for cross linking and chain breaking, respectively. The 10-kC ^{60}Co facilities at JAER and a Van de Graaff accelerator at the Inst. Phys. and Chem. Res., Tokyo, were used. Test results were graphed indicating the relations for induced current, and decay current after cessation vs dosage rate, temperature dependence of the induced current, ohmic characteristics of the induced

current, decay rate of the current after cessation, and temperature dependence. Under irradiation the insulation resistance was lowered by the order of 2 to 3, which suggested that the charge carriers are predominantly electrons. The conduction electrons had a tendency to recombine by a 2-mole reaction at room temperature and a 1-mole reaction at lower temperature. The transition temperature where the recovery of insulation resistance accelerated on cessation of the irradiation was about −40°C. (OID)

43622 CALORIMETRIC STUDY OF RADIATIVE SOLID-PHASE POLYMERIZATION OF ACRYLONITRILE AT 135°K. D. A. Kritskaya, I. K. Larin, A. N. Ponomarev, and Y. L. Tal'roze (Inst. of Chemical Physics, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Khim., No. 7, 1356(July 1964). (In Russian)

Radiative polymerization of acrylonitrile was studied in $\sim 10^{-5}$ cm layers exposed to high doses. The yield of G polymer at 0.8 to 8.5 Mrad/sec was measured as a function of dose. As the dose was increased the G magnitude decreased from 120 polymerization events per 100 ev (at 0.85 Mrad/sec) to 50 (at 8.5 Mrad/sec). The rate of polymerization was strongly proportional to absorbed dose. (R.V.J.)

43623 INTERNAL PHOTOEFFECT IN SOLID HEPTANE IRRADIATED BY FAST ELECTRONS. E. L. Frankevich and B. S. Yakovlev (Inst. of Chemical Physics, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Khim., No. 7, 1357-8(July 1964). (In Russian)

The behavior of charged particles and their participation in radiochemical process were studied by measuring electric conductivity (σ) in heptane irradiated at 80°K by 1.6-Mev electrons. The results showed that the σ is a function of radiation dose (I) as described by $\sigma = kI^{\Delta}$, where Δ increased from 0.55 to 0.98 with a radiation dose increase from 6×10^{-3} to 4 Mrad/sec. (R.V.J.)

43624 CONVERSION OF CO–H_2 MIXTURES BY FAST ELECTRONS. B. M. Mikhailov, V. G. Kiselev, and V. S. Bogdanov (Zelinskii Inst. of Organic Chemistry, Academy of Sciences, USSR). Izv. Akad. Nauk SSSR, Ser. Khim., No. 8, 1524-6(Aug. 1964). (In Russian)

Glyoxal, carbon dioxide, and carbon suboxides are the radiolysis products produced in fast electron irradiation of CO and H_2 mixtures. The glyoxal is produced by joining two carbon oxide molecules into bicarbonyl, followed by reaction with hydrogen. (R.V.J.)

43625 AN ELECTRON SPIN RESONANCE STUDY OF X-IRRADIATED FUMARIC ACID-UREA CRYSTALS. O. Hayes Griffith and Alvin L. Kwiram (California Inst. of Tech., Pasadena). J. Am. Chem. Soc., 86: 3937-41 (Oct. 5, 1964).

Single crystals of the monoclinic fumaric acid–urea crystals were x irradiated at room temperature and investigated by electron spin resonance. The urea molecules of this crystal minimize polymerization of fumaric acid and permit an investigation of x-ray-produced monomer radicals. The dominant radical observed was the well-known $HO_2CCH_2\dot{C}HCO_2H$ radical. The α-proton tensor was obtained and the major orientations of this radical were related to the crystal morphology. Single crystals of succinic acid–urea and adipic acid–urea were also briefly investigated and the orientations of the x-ray produced carboxylic acid radicals ($R\dot{C}HCO_2H$) in all three molecular compounds were the same with respect to the three very similar crystal morphologies. The degree of radical motion in the fumaric acid–urea, succinic acid–urea, and adipic acid–urea crystals was much less than that of similar radicals in the hexagonal urea inclusion compounds. (auth)

43626 KINETICS OF IONIC PROCESSES IN THE RADIOLYSIS OF LIQUID CYCLOHEXANE. Ffrancon Williams (Univ. of Tennessee, Knoxville). J. Am. Chem. Soc., 86: 3954-7(Oct. 5, 1964). (TID-21123)

Ammonia-d_3 was used as a proton scavenger in the radiolysis of liquid cyclohexane. The kinetics of proton transfer from cyclohexane ions were studied by measuring the yield of HD as a function of ND_3 concentration. In agreement with other work, the G-yield of free ions is 0.08. The majority of ions undergo germinate recombination, but it is estimated that the lifetimes of about half these ions lie in the range 10^{-9} to 10^{-7} sec. Ionic reactions can therefore proceed in the presence of high concentrations of a very reactive scavenger. A simple diffusion model of germinate ionic recombination predicts a lifetime for the ion pair which varies as the cube of the initial separation distance. Calculations according to this model are in semiquantitative agreement with the experimental results. (auth)

43627 PULSE RADIOLYSIS OF GASES. Myran C. Sauer, Jr. and Leon M. Dorfman (Argonne National Lab., Ill.). J. Am. Chem. Soc., 86: 4218-19(Oct. 5, 1964).

Pulse radiolysis studies were made on rare gas–naphthalene systems and atomic and molecular oxygen. The triplet state of naphthalene was observed, and the absolute rate constant for the reaction of oxygen atoms with molecular oxygen to form ozone was determined. The naphthalene system irradiated consisted of 10 to 30 atm of Xe and about 0.1 mm of naphthalene. A transient absorption spectrum was observed, consisting of three bands centered at 3984, 3772, and 3430 A, with half-widths of about 60–70 A and relative optical densities at the maxima of 1.0, 0.4, 0.1, respectively. This spectrum was assigned to the triplet state of naphthalene. The ozone formation reaction was investigated over an oxygen pressure range of 7 to 130 mm with argon present at pressures up to 100 atm. The data obtained on the formation rate constant for ozone give $k_1 = (0.7 \pm 0.3) \times 10^{14}$ (cc $mole^{-1})^2$ sec^{-1} at 25°C. (P.C.H.)

43628 EFFECTS OF γ RADIATION ON THE SURFACE PROPERTIES OF SILICA AS STUDIED BY THE INFRARED SPECTRA OF ADSORBED MOLECULES. D. J. C. Yates and P. J. Lucchesi (Esso Research and Engineering Co., Linden, N. J.). J. Am. Chem. Soc., 86: 4258-65(Oct. 20, 1964).

The effect of γ radiation on high area oxides was mainly studied by indirect means. For example, the rate of H_2-D_2 exchange on silica was found to be markedly affected by radiation. Infrared spectroscopy as a tool for the study of adsorbed molecules offers a more direct approach to studying the effect of radiation on surface properties. It is shown that dissociative ethylene chemisorption can be induced in silica by γ radiation. Careful control experiments showed that no ethylene was adsorbed on the surface without prior irradiation. The nature of the adsorbed species, the mechanism of growth of the adsorbed species, and the nature of the active sites induced by the radiation are discussed. (auth)

43629 RANGE OF VALIDITY OF BORN APPROXIMATION FOR MOLECULAR FRAGMENTATION FOLLOWING HIGH-ENERGY PROTON AND ELECTRON IMPACT. S. Wexler (Argonne National Lab., Ill.). J. Chem. Phys., 41: 2781-90(Nov. 1, 1964).

Arguments based on the Born approximation lead to the expectation that the ionic fragmentation pattern of a polyatomic molecule is independent of the nature of the ionizing and exciting charged projectile provided the velocity is the same and is sufficiently high. An experimental assessment of this expectation was made. The patterns of positively charged fragments of methane, acetylene, ethylene, ethane, propane, and n-butane from bombardment of these molecules with 2.25-Mev protons were compared with the mass spectra resulting from impact of 1225-ev electrons. At these energies the velocities of the two particles are 2×10^9 cm/sec, 9.5 times the Bohr velocity. The relative abundances of the more prominent ionic species were observed to be generally in good agreement, but large differences were found for ions of low yield. Almost invariably, the fragments were produced in higher abundances relative to the parent ion in electron impact than in proton bombardment. The apparent failure of the Born approximation for describing molecular dissociation in high-energy-transfer collisions was expressed for each fragment quantitatively as the deviation from unity of the ratio of relative abundances from the electron and proton bombardments. Correlations of these deviations with several other characteristics of inelastic collision processes were made. At the velocity employed the Born approximation is found to be valid for a large fraction of the ionizing and exciting collisions of almost all the target molecules. The apparent failure of the approximation appeared to be related to the amount of energy transferred to the struck molecule by the projectile and to the kinetic energy of the fragment. (auth)

43630 RATE CONSTANTS FOR THE REACTION OF THE HYDROXYL RADICAL WITH AROMATIC MOLECULES. Leon M. Dorfman, Irwin A. Taub, and Douglas A. Harter (Argonne National Lab., Ill.). J. Chem. Phys., 41: 2954-5(Nov. 1, 1964).

The absolute rate constants for the reaction of the hydroxyl radical with toluene and benzoic acid were determined. All experiments were carried out at pH 3 in deaerated aqueous solutions acidified with perchloric acid using pulse radiolysis. The rate constants were $(3.3 \pm 0.8) \times 10^9$ and $(3.0 \pm 0.7) \times 10^9$ M^{-1} sec^{-1} for benzene and toluene, respectively. In both cases the reaction was primary ring addition. This was also true for benzoic acid, which showed a reaction rate constant of $(2.1 \pm 0.3) \times 10^9$ M^{-1} sec^{-1}. (M.C.G.)

43631 STUDIES ON THE CONTRIBUTION OF IONIC CHARGE IN THE HOT ATOM REACTIONS ORGANIC IODIDES. R. Mahadeva Iyer and S. R. Narayan (Atomic Energy Establishment, Trombay, India). J. Inorg. Nucl. Chem., 26: 1653-6(Oct. 1964).

Results obtained on the beta decay of $^{132}Te \rightarrow {}^{132}I$ in an attempt to assess the contribution of ionic charge to the subsequent chemical reaction of the recoiling atom in organic systems are presented. The influence of isopropyl ether and of nitrate complexing on the organic retention was studied. It was found that even when the ether content of the complex was increased twofold, or when the nitrate complex of tellurium was used as the source of ^{132}Te instead of the chloride complex, the retention pattern did not alter. In order to determine the nature of the ^{132}I atom reactions, a scavenger technique was used with small amounts of molecular iodine. (M.C.G.)

43632 RADIOCHEMICAL PROCESSES IN IRIDIUM COMPLEXES. PRODUCTS FROM (n,γ) PROCESS IN SODIUM CHLOROIRIDATE AND CHLOROIRIDITE. J. M. Peixoto Cabral (Junta de Energia Nuclear, Sacavém, Portugal). J. Inorg. Nucl. Chem., 26: 1657-69(Oct. 1964).

It is shown that in apparently pure solution chloroiridate there is a mobile redox equilibrium involving chloroiridate and chloroiridite. The principal products obtained on dissolving neutron-irradiated sodium chloroiridate or sodium chloroiridite crystals are shown to be the aquo species derived by substitution of the chloride ligands in the chloroiridite anion and other species that may be polynuclear complexes and hydroxy species. (auth)

43633 PREPARATION OF FLUORINE-18. SEPARATION IN ALUMINA COLUMN, AND THE CHEMICAL FORM OF ^{18}F OBTAINED. Eiji Shikata (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 1: 183-8(Sept. 1964).

Fluorine-18 was prepared by neutron irradiation of lithium carbonate in the reactor JRR-1. Five grams of lithium carbonate were irradiated for 2 hr with a thermal neutron flux of 6×10^{11} $n/cm^2/sec$. An alumina column was used to separate ^{18}F from the irradiated material. The various factors that affect the separation were studied, and purity and specific activity were determined. About 90 μC of ^{18}F per gram of lithium carbonate were prepared by this method with a chemical yield exceeding 80%. The prepared ^{18}F was pure enough radiochemically but contained a small amount of lithium and aluminum. The specific activity was about 0.5 mC/mgF. The chemical form of the ^{18}F obtained by the above method was studied by paper-chromatography. A sample was developed on filter paper by the ascending method using butanol-methanol-water mixture as solvent, and the distribution of ^{18}F radioactivity was determined. From the results of the paper-chromatographic study, it was found that most of the ^{18}F existed in the form of fluoride but about 16% in another form, possibly a complex with aluminum. (auth)

43634 PHOTOLYSIS AND RADIOLYSIS OF AQUEOUS SOLUTIONS AT HIGH RADIATION INTENSITIES. J. K. Thomas and Edwin J. Hart (Argonne National Lab., Ill.). J. Phys. Chem., 68: 2414-18(Sept. 1964).

Pulsed radiolysis and photolysis of water and methanol solutions was carried out using 1.4-μsec pulses of 13-Mev electrons and 20-μsec pulses of ultraviolet light. The experimental conditions were usually such that no significant reaction occurred during the pulse or flash. By measurement of hydrogen yields on neutral and acid solutions, it was concluded that the photolysis of water forms hydrogen atoms. By contrast, radiolysis produces hydrated electrons as the dominant reducing species. A rate constant of $(1.0 \pm 0.5) \times 10^{10}$ M^{-1} sec^{-1} was found for the reaction, $H + CH_2OH$. (auth)

43635 ON THE RADIATION CHEMISTRY OF CONCENTRATED AQUEOUS SOLUTIONS OF SODIUM BENZOATE. Israel Loeff and A. J. Swallow (Imperial Coll. of Science and Tech., London). J. Phys. Chem., 68: 2470-5 (Sept. 1964).

The radiation chemistry of sodium benzoate in aerated aqueous solution at concentrations up to 2.9M was investigated with the help of colorimetric and ^{14}C methods. A hitherto unknown product, a dialdehyde, was found. All products except carbon dioxide appear to be formed only by an indirect mechanism but carbon dioxide is formed by both indirect and direct mechanisms. The dependence of the product yields on concentration does not fit a simple theory in which energy absorption by the two components is proportional only to outer electron fraction (or elec-

tron fraction). It seems likely that the aromatic ring is taking up more of the radiation energy than would be expected on such a basis, as observed previously in purely organic mixtures containing substances possessing π-electrons. (auth)

43636 THE $N^{14}(n,p)C^{14}$ HOT ATOM CHEMISTRY OF CARBON IN HYDRAZINE SULFATE. John D. Vaughan and Van T. Lieu (Univ. of Hawaii, Honolulu and Virginia Polytechnic Inst., Blacksburg). J. Phys. Chem., 68: 2497-2501 (Sept. 1964).

Chemical separations were made of the radiocarbon activities produced when pile neutron-irradiated hydrazine sulfate crystals are dissolved in water. A wide variety of labeled one-carbon compounds were found. Cyanamide, methylamine, and guanidine were formed in the largest amounts; other radio compounds found were carbon dioxide, carbon monoxide, formic acid, formaldehyde, urea, methylhydrazine, and three species that have the properties of cyanic acid, methylenediamine, and formamidine. Paths leading to these products are suggested. (auth)

43637 CHEMICAL EFFECTS OF THE NUCLEAR ISOMERIC TRANSITION OF Br^{80m} IN GLASSY AND POLYCRYSTALLINE ALKYL BROMIDES. Rolf M. A. Hahne and John E. Willard (Univ. of Wisconsin, Madison). J. Phys. Chem., 68: 2582-9(Sept. 1964). (COO-32-101)

The chemical fate of ^{80}Br atoms born from the $^{80m}Br \rightarrow {}^{80}Br$ isomeric transition was determined in glassy and polycrystalline n-C_3H_7Br and n-C_4H_9Br under varied conditions of Br_2 concentration, temperature, sample preparation, and parent chemical species of the ^{80m}Br. The organic yields from $Br^{80m}Br$ in polycrystalline n-C_3H_7Br are essentially independent of Br_2 concentration over a wide range, supporting other evidence that the bromine is present as a homogeneous solution and indicating that the fate of the ^{80}Br is determined very close to the site of birth. Organic yields from $Br^{80m}Br$ in n-C_4H_9Br are higher in the glassy state than the polycrystalline state. In both glassy and polycrystalline n-C_4H_9Br the organic yields when the ^{80m}Br is in the form of n-$C_4H_9{}^{80m}Br$ are much higher than when it is in the form of $Br^{80m}Br$. In polycrystalline samples they are not appreciably changed by the presence of 5×10^{-3} mole fraction of Br_2 but are significantly reduced by this concentration of bromine in glassy samples. The organic yield from 0.01 mole fraction $Br_2(^{80m}Br)$ in polycrystalline n-C_6H_{14} at 77°K is increased from 3 to 20% by addition of 0.01 mole fraction of n-C_3H_7Br. Electron spin resonance (esr) observations show that the nature and annealing characteristics of the trapped radicals produced in solid n-C_4H_9Br by γ irradiation differ for the glassy and polycrystalline forms. There is also a substantial difference in the ratios of individual stable products formed by the γ irradiation of glassy n-C_3H_7Br as compared to the crystalline form. (auth)

43638 RADIOLYSIS OF FROZEN SOLUTIONS. I. FORMATION OF NITROGEN DIOXIDE IN SODIUM NITRATE ICES. Larry Kevan (Univ. of Chicago). J. Phys. Chem., 68: 2590-4(Sept. 1964). (COO-1365-1)

The principal nitrogen-containing paramagnetic species formed at 77°K in γ irradiated frozen sodium nitrate solutions is the NO_2 radical. The NO_2 yield is linear with radiation dose to only 0.04 Mrad and is proportional to $[NaNO_3]^{1/2}$. A diffusion kinetic model in which H_2O^+ is the diffusing species that reacts according to $H_2O^+ + NO_3^- \rightarrow NO_3^* \rightarrow NO_2 + O$ fits this concentration behavior. As expected from this model experiments with added electron scavengers do not affect the NO_2 yield. Also, the NO_3 radical was tentatively identified as being present in minor yield. (auth)

43639 RADIOLYSIS OF THE CRYSTALLINE ALKALI METAL BROMATES BY NEUTRON REACTOR RADIATIONS. G. E. Boyd and Q. V. Larson (Oak Ridge National Lab., Tenn.). J. Phys. Chem., 68: 2627-34(Sept. 1964).

Radiations in the active lattice of the Oak Ridge graphite reactor were employed to radiolyze bromate ion to varying degrees in each of the crystalline alkali metal bromates. The decomposition of BrO_3^- gave oxidizing fragments, bromide ion, and occluded oxygen gas in the crystals in amounts that depended on the compound and on the radiation dose it absorbed. Ceric sulfate dosimeter solutions and thermal neutron flux monitors were employed to measure the absorbed doses, and initial 100-ev yields at 40°C were derived for bromate decomposition, $G_0(-BrO_3^-)$, oxidizing fragment formation, $G_0(\text{"Ox"})$, and bromide ion production, $G_0(Br^-)$. The yields for all the salts except $LiBrO_3$ were the same within experimental error as observed previously with ^{60}Co γ rays. The production of high LET tritons and α particles by ^6Li fission was responsible for the significantly larger yields of $LiBrO_3$. The nonlinear dependence of the formation of oxidizing fragments and bromide ion on the absorbed dose was explained by a radiolytic mechanism in which the concentrations were governed by a sequence of first-order irreversible reactions. (auth)

43640 RADIOLYSIS OF CYCLOHEXENE. I. PURE LIQUID. B. R. Wakeford and G. R. Freeman (Univ. of Alberta, Edmonton, Can.). J. Phys. Chem., 68: 2635-8 (Sept. 1964).

The yields of the major products were essentially independent of dose and dose rate over the ranges studied. The dimeric products appear to have been formed by the combination of free radicals. Direct ionic dimerization does not occur to an appreciable extent. The low yield of 1,3-cyclohexadiene ($G < 0.1$) relative to the yield of 2,2′-dicyclohexenyl ($G = 1.9$) indicates that the disproportionation–combination ratio for 2-cyclohexenyl radicals has a value of <0.05. An ionic mechanism is suggested for the formation of over half of the cyclohexane. Direct elimination of molecular hydrogen from activated cyclohexene species occurs only to a small extent, if at all ($G(\text{molecular } H_2) < 0.25$). (auth)

43641 THE RADIOLYSIS OF AQUEOUS METHANOL–SODIUM NITRATE SOLUTIONS. J. T. Allan (Mellon Inst., Pittsburgh). J. Phys. Chem., 68: 2697-2703(Sept. 1964). (RRL-134)

Radiation chemical studies were carried out on deaerated, aerated, and oxygenated aqueous methanol–sodium nitrate solutions. The reduction of nitrate to nitrite by hydrated electrons was found to proceed via the intermediate formation of the radical-ion NO_3^{2-}. In oxygenated solutions, the competition between O_2 and NO_3^- for the hydrated electrons was investigated; the ratio of rate constants was found to be $k_{e_{aq}^- + O_2}/k_{e_{aq}^- + NO_3^-} = 1.15 \pm 0.2$. Nitrite ions were produced according to $NO_3^{2-} + H^+ \rightarrow NO_2 + OH^-$ and $2NO_2 + H_2O \rightarrow 2H^+ + NO_2^- + NO_3^-$, and $G(NO_2^-) = \frac{1}{2}G(e_{aq}^-)$. In the deaerated system, nitrite yields were determined by competition reactions involving NO_3^{2-}, the organic radicals CH_2OH, and hydrogen ions, the predominant process being $CH_2OH + NO_3^{2-} \rightarrow CH_2O + NO_2^- + OH^-$; thus $G(NO_2^-)$ was approximately equal to $G(e_{aq}^-)$. The product yields were accounted for on the basis of the initial

production of two reducing species, e^-_{aq} and H, in the aqueous alcohol solutions. The yield of hydrated electrons in the bulk of a neutral solution was found to be $G(e^-_{aq}) = 2.80 \pm 0.15$ for both oxygenated and deaerated solutions. (auth)

43642 THE ACTION OF IONIZING RADIATIONS ON AQUEOUS OXYGENATED SOLUTIONS OF ACETALDEHYDE. J. T. Allan (Mellon Inst., Pittsburgh). J. Phys. Chem., 68: 2714-16(Sept. 1964). (RRL-137)

Oxygenated solutions of acetaldehyde (O_2-acetaldehyde) were irradiated with ^{60}Co gamma rays or 2.5 Mev electrons. The initial products detected in the aqueous solutions were acetic acid, formaldehyde, hydrogen peroxide, and two hydroperoxides. One of the hydroperoxides was subsequently identified as peracetic acid, CH_3COO_2H; the second is assumed to be peroxyacetaldehyde, $OHCCH_2O_2H$. The results indicate that the peroxide yields were largely determined by radioinduced chain processes involving acetaldehyde. In solutions irradiated with higher dose-rate electrons, the radical-solute reactions responsible for chain initiation were effectively eliminated. (P.C.H.)

43643 RADIATION-INDUCED REACTIONS OF ISOPROPYLBENZENE ON SILICA–ALUMINA. Robert R. Hentz (Socony Mobil Oil Co. Inc., Paulsboro, N. J.). J. Phys. Chem., 68: 2889-94(Oct. 1964).

Experiments are reported on the reaction of isopropylbenzene on three γ irradiated silica–aluminas that differed in impurity content and method of preparation. In each of these solids, radiation produced coloration; the solids were bleached by isopropylbenzene and benzene was formed. At high doses the yield of benzene reached a limiting value that was different for each solid. This maximum benzene yield failed to correlate with iron content (the major impurity) but did correlate, perhaps fortuitously, with the inherent dealkylation activity of these three solids. The most active solid gave a limiting yield of 162×10^{17} benzene molecules/g. Gamma irradiation of a heterogeneous system comprised of isopropylbenzene and a high-purity silica–alumina also was studied over the entire range of isopropylbenzene electron fraction. G(benzene) = 1.2 from low surface coverage to beyond complete surface coverage. Gas yields for the irradiated heterogeneous system also are presented and interpreted in terms of a mechanism that involves hydrogen atoms generated from surface O–H bonds of the solid by absorbed radiation energy. (auth)

43644 STEADY-STATE RADIOLYSIS OF GASEOUS OXYGEN. Kenji Fueki and John L. Magee (Univ. of Notre Dame, Ind.). J. Phys. Chem., 68: 2901-8(Oct. 1964).

Gaseous oxygen under steady irradiation maintains a rather small amount of ozone, only a few parts per million, depending upon the pressure, rate of irradiation, etc. The hypothesis that the ozone concentration is limited by a negative ion–molecule chain decomposition was considered in detail and found to be consistent with the known facts. At the higher gas densities where track effects must be considered the sharp-boundary method was employed. (auth)

43645 ELECTRICAL CONDUCTIVITY OF LIQUID AMMONIA DURING γ-RAY IRRADIATION. Rolland W. Ahrens, Bulusu Suryanarayana, and John E. Willard (Univ. of Wisconsin, Madison). J. Phys. Chem., 68: 2947-52(Oct. 1964). (COO-32-102)

A reversible increase in the electric conductivity of liquid ammonia was observed upon exposure to γ irradiation at a dose rate of about 10^{18} ev g^{-1} min^{-1} ($\sim 10^6$ R hr^{-1}). This implies escape of radioinduced electrons from the parent positive ions to form separated ion pairs. If the equivalent conductance is assumed to have the value reported for sodium in liquid ammonia, and the recombination rate constant is assumed to be the same as that for the reaction of solvated electrons in water with hydronium ion, the steady-state ion-pair concentration was about 4×10^{12} ml^{-1} and G(ion pairs) for the different types of measurements made fell in the range 0.5 to 3. Any reasonable choice of the variable parameters seems to require substantial electron escape. Technical problems in the determination of the conductivity of liquid ammonia during irradiation are discussed. (auth)

43646 ON THE RADIOLYSIS OF ALKALI HALIDES IN AQUEOUS SOLUTIONS SATURATED WITH NITROUS OXIDE. M. Anbar, D. Meyerstein, and P. Neta (Weizmann Inst. of Science, Rehovoth, Israel and Soreq Research Establishment, Rehovoth, Israel). J. Phys. Chem., 68: 2967-70(Oct. 1964).

The radiolytic oxidation of iodide ions in N_2O-saturated solutions was investigated over the range of 10^{-4} to 1.0 M KI. $G(I_2)$ was found to increase with iodide concentration up to 3.65 at 1 M KI. This result implies the formation of oxidizing species other than OH radicals in radiolyzed solutions. Fluoride, chloride, and bromide ions were also found to react with these species. (auth)

43647 RADIOLYSIS OF CYCLOHEXENE. II. EFFECTS OF ADDITIVES. B. R. Wakeford and G. R. Freeman (Univ. of Alberta, Edmonton). J. Phys. Chem., 68: 2992-7(Oct. 1964).

The addition of benzene and 1,3-cyclohexadiene inhibited the formation of all of the major products of the cyclohexene radiolytic system, the latter additive having the more marked effects. The addition of 1,4-cyclohexadiene enhanced the cyclohexane yield slightly, but inhibited the formation of the remaining cyclohexene products. Of the three additives, 1,3-cyclohexadiene gave a relatively much greater yield of polymer and had the highest rate of disappearance. Benzene apparently gave sponge type protection to cyclohexene. Activation transfer from cyclohexene to 1,3-cyclohexadiene was clearly demonstrated by the formation of dicyclohexadienyl in good yield ($G \approx 6$) at low diene concentrations (about 2 mole %). This diene probably also acted as a radical scavenger. The effects of 1,4-cyclohexadiene appeared to be best explained by a combination of activation transfer and free radical reactions. (auth)

43648 IRRADIATION EFFECTS IN THE PLATINUM-CATALYZED DEUTERIUM EXCHANGE OF WATER WITH BENZENE AND OTHER SUBSTANCES. W. G. Brown, J. L. Garnett, and O. W. VanHook (Argonne National Lab., Ill.). J. Phys. Chem., 68: 3064-6(Oct. 1964).

Prior irradiation of the D_2O–C_6H_6–PtO system with gamma rays or uv radiation was found to have an accelerating effect on deuterium exchange. The results illustrate, in the early buildup of highly deuterated species, the relative importance of sites favorable for multiple exchange, in this mode of activation. It appears that photochemical excitation in platinum oxide and a resultant interaction with water may be involved in the generation of active centers that grow or multiply during the subsequent heat incubation. Studies were also made on systems containing cyclohexane and pyridine. (P.C.H.)

43649 ELECTRON SPIN RESONANCE STUDIES OF RADICAL REACTIONS IN IRRADIATED ALKYL HALIDES AT LOW TEMPERATURES. P. B. Ayscough and H. E. Evans (Univ. of Leeds, Eng.). J. Phys. Chem., 68: 3066-8 (Oct. 1964).

Electron spin resonance studies on the behavior of organic radicals radioinduced in alkyl halides are reported. Isobutene, isobutane, isobutyl bromide, and t-butyl bromide were used. The results showed that apart from recombination, the three most likely reactions of isobutyl radicals in this system are isomerization, bromine abstraction, and addition to olefin. The experiments using monodeuterated t-butyl bromide showed that bromine abstraction is negligible, and addition to olefin is eliminated by the negligible effect of added butene-1 and isobutene. (P.C.H.)

43650 ON THE MECHANISM OF BENZENE FORMATION IN THE RADIOLYSIS OF ACETYLENE. Yves Rousseau and Gilbert J. Mains (Carnegie Inst. of Tech., Pittsburgh). J. Phys. Chem., 68: 3081-2(Oct. 1964).

Studies were made on the mechanism of benzene formation involving scission of the carbon-carbon triple bond in the radiolysis of acetylene. Acetylene enriched in ^{13}C was used. Both photolysis and radiolysis results conformed very closely to that predicted for a mechanism involving no carbon-carbon bond cleavage. It was concluded that any such process must play a minor role in the mechanism of benzene formation. (P.C.H.)

43651 TEMPERATURE DEPENDENCE OF CRITICAL RESOLVED SHEAR STRESS IN IRRADIATED SODIUM CHLORIDE CRYSTALS. Touichi Okada and Toluo Suita (Osaka Univ.). J. Phys. Soc. Japan, 19: 1495-6(Aug. 1964).

Experimental results on the temperature dependence of the critical resolved shear stress of γ-irradiated sodium chloride crystals are reported. These results are compared with the theory of Fleischer which is based on the model that mobile dislocations interact with tetragonal defects and overcome the barriers with the help of thermal activation. (C.E.S.)

43652 EFFECT OF GAMMA RADIATION ON THE SPECIFIC VOLUME OF POLYTETRAFLUOROETHYLENE FROM −80°C TO +40°C. W. R. Licht and D. E. Kline (Pennsylvania State Univ., University Park). J. Polymer Sci., Pt. A, 2: 4673-82(Oct. 1964).

Specific volume vs temperature relationships for γ irradiated polytetrafluoroethylene (PTFE) samples ($\frac{1}{2}$ in. diameter rods) were studied over the −80 to +40°C temperature range for radiation doses up to 890 Mrads. At low doses, the overall specific volume decreases with increasing dose. Between 100 and 300 Mrads the effect reverses, and the specific volume increases with dose up to 890 Mrads. As reported in the literature, an inflection point associated with the first-order crystalline transition appears in the specific volume curve near 19°C for unirradiated PTFE. This inflection point loses definition and shifts to lower temperatures with increasing radiation dose. At 890 Mrads the inflection point has decreased about 50°C to near −33°C. Effects noted in irradiated PTFE are attributed to chain scission, changes in per cent crystallinity, and eventual disordering of the crystallites with increasing radiation dose. No significant differences in results were detected between samples irradiated in air and samples irradiated in vacuum-sealed containers. (auth)

43653 ON THE LIMITING CONCENTRATION OF RADICALS IN THE LOW-TEMPERATURE RADIOLYSIS OF AROMATICS. V. I. Trofimov, I. I. Chkheidze, and N. Ya. Buben (Inst. of Chemical Physics, Academy of Sciences, USSR). Kinetika i Kataliz, 4: 736-9(July-Aug. 1964). (In Russian)

The curves of radical accumulation in irradiated aromatic systems (phenol at 207°K, p-aminophenol at 123°K, benzene at 140°K, 1-cyclohexyl 1-phenyl dodecane at 140°K, and paraffin at 129°K) were studied using a 1.6-Mev electron beam and a maximum dosage of 3000 Mrad at 0.05 to 0.7 Mrad/sec. The data showed two large concentration groups: one group of benzene derivatives with polar substitutes (phenol, aniline, chlorobenzene, etc.) with maximum radical concentrations of 10^{18} to 10^{19} g, and a second group of benzene derivatives with alkyl substitution in which the maximum concentration was not found, but which showed a linear concentration dependence on absorbed dose. The concentration of radicals remained constant after irradiation was stopped. (R.V.J.)

43654 H−D ISOTOPE EFFECTS IN THE DECOMPOSITION OF ACETYLENE BY ELECTRON IMPACT. P. C. Haarhoff (Cambridge Univ., Eng.). Mol. Phys., 8: 49-63 (1964).

In an attempt to gain a better insight into the decomposition of small polyatomic molecules by irradiation, H−D isotope effects in the mass spectrum of acetylene are predicted by means of the quasi-equilibrium theory of mass spectra, and are compared with observed effects. The qualitative agreement between calculated and experimental isotope effects for fragment ions is good, and the quantitative agreement is fair in view of the uncertainty in several quantities, especially in the excitation energy distribution for molecular ions. It is concluded that the quasi-equilibrium theory provides a satisfactory account of the main phenomena that determine the decomposition pattern. There are however several indications that excitation energy is not completely randomly distributed in ions, and this might have to be taken into account in more refined treatments. (auth)

43655 FORMATION OF TRIPLET STATES OF SOLUTES IN THE RADIOLYSIS OF ORGANIC LIQUIDS. F. S. Dainton (Univ. of Leeds, Eng.), T. J. Kemp, G. A. Salmon, and J. P. Keene. Nature, 203: 1050-2(Sept. 5, 1964).

The transient absorption spectra produced by short pulses (dose ≃ 6500 rads in 2 μ sec) of 4-Mev electrons incident on dilute solutions, generally about 10^{-2}M in concentration, of naphthalene or benzophenone or biphenyl in various aprotic organic liquids at room temperature were investigated in an attempt to determine the mechanism of formation of triplet states of solutes. (C.E.S.)

43656 HYDROXYL IONS IN THE MASS SPECTRUM OF WATER VAPOUR. B. C. De Souza and J. H. Green (Univ. of New South Wales, Kensington, Sydney). Nature, 203: 1165(Sept. 12, 1964).

The existence of stable primary OH^- ions in the negative ion mass spectrum from the electron impact dissociation of water was investigated. (C.E.S.)

43657 ELECTRODEPOSITION TECHNIQUES FOR THE PREPARATION OF BETA-SPECTROSCOPY SOURCES OF RARE-EARTH ELEMENTS. P. G. Hansen, J. Hoegh, and H. L. Nielsen (Research Establishment, Risø, Denmark). Nucl. Instr. Methods, 30: 161-4(Nov. 1964).

Thin, uniform radioactive deposits of rare earths and related elements can be prepared by cathodic electrodeposition of their hydroxides. The main theoretical and experimental features of this process are reviewed; and plating cell design and the choice of conditions are described, together with the associated radiochemical methods. The use of copper-backed nickel films is shown to allow the preparation of beta sources on quite thin (down to 45 $\mu g\ cm^{-2}$) backings, if the copper layer is etched selectively after the radioactivity has been plated onto the nickel. (auth)

43658 STUDY OF MOLECULAR ROTATIONS IN SOLIDS AND LIQUIDS BY THE INELASTIC SCATTERING

OF COLD NEUTRONS. J. A. Janik, J. M. Janik, J. Mellor, and H. Palevsky (Brookhaven National Lab., Upton, N. Y.). Phys. Chem. Solids, 25: 1091-8(Oct. 1964). (BNL-7876)

The spectra of scattered neutrons from molecular crystals and liquids containing rotating molecular groups were obtained. The materials studied were liquid CH_4, CH_3I, and dimethylacetylene; NH_4ClO_4, NH_4PF_6, H_3OClO_4, and dimethoxyazoxybenzene. The observed spectrum from liquid CH_4 was used as a comparison standard for freely rotating NH_4^+ ions and the CH_3I spectrum was used for comparison to H_3O^+ and CH_3 groups possessing single axis rotational freedom. All measured spectra were compared to those calculated from the Krieger-Nelkin, Sachs-Teller theory. (auth)

43659 SOME REMARKS UPON THE RELATION BETWEEN THE DOSE OF IRRADIATION AND THE INTENSITY OF LUMINESCENCE OF THE SCREEN. Jerzy Wojtowicz. Polski Przeglad Radiol. i Med. Nuklearnej, 28: 377-80(1964). (In Polish)

The intensity of luminescence is in linear relation with the dose of irradiation up to doses of several R/sec. The intensity of luminescence of the secondary screen in the electronic image intensifier is in linear relation with the magnitude of irradiation up to 1.0 R/sec. Above this dose an effect of saturation may be observed. It seems that the observed phenomenon is of little practical value, because in the cineradiographic procedures the magnitude of irradiation of the primary screen of the electronic image intensifier is usually smaller for about two ranges of magnitude than the above given value. (auth)

43660 MEASUREMENTS OF THE ABSOLUTE BETA-ACTIVITY OF 1 TO 10 mg/cm^2 THICK PREPARATIONS. M. Ya. Kondrat'ko, O. P. Nikotin, and K. A. Petrzhak. Pribory i Tekhn. Eksperim., No. 3, 47-51(May.-June 1964). (In Russian)

A method of applying uniform layers of radioactive materials with low specific activity to thin substrates is described. Proportional 4π counters were used to study radiation absorption within the sample layers for isotopes with simple beta decay schemes. The results are used to make corrections for the self-absorption of beta radiation in isotopes with known decay schemes. The 4π counter is recommended as a device for making absolute standard measurements of beta activity of weighted samples. The method has an accuracy of 2–3% for the majority of beta radiators. (auth)

43661 A DEVICE FOR DETERMINING THE RADIOSENSITIVITY OF SUPERHEATED LIQUID. V. P. Skripov and V. N. Cherepanov (Urals Polytechnic Inst., USSR). Pribory i Tekhn. Eksperim., No. 3, 192-5(May-June 1964). (In Russian)

A method of superheating small drops of the studied liquid, floating in a specially selected liquid medium, was used. The limits of radiation sensitivity of several materials at atmospheric pressure were determined. Data are presented for n-pentane at 1.0 and 6.5 atm. Comparison with results of measurements in clean and dirty bubble chambers testify to the possibilities of the new method. (tr-auth)

43662 PULSE RADIOLYSIS AND MATRIX ISOLATION DATA FOR METHANOL AND 2-METHYLTETRAHYDROFURAN (MTHF). F. S. Dainton (Univ. of Leeds, Eng.), J. P. Keene, T. J. Kemp, G. A. Salmon, and J. Teplý. Proc. Chem. Soc., 265-6(Aug. 1964).

Studies were made on the transient spectra produced by short pulses of 4-Mev electrons incident on solutions in methanol or 2-methyltetrahydrofuran (MTHF) or on the pure solvents in the liquid state at room temperature and the optical and ESR spectra produced on the γ irradiation of similar systems in the glassy state and their dependence on subsequent illumination or warming. For both media the dominant primary species are an electron and a free radical corresponding to the solvent molecule minus a hydrogen atom. Both species absorb at longer wavelengths in the liquid than in the glass and generally disappear in diffusion controlled reactions. The major observations and the reactions responsible are summarized. (P.C.H.)

43663 SOLUTE ISOTOPE AND pH EFFECTS ON THE PRIMARY SPECIES PRODUCED IN THE PULSE RADIOLYSIS OF WATER. D. M. Brown (Univ. of Leeds, Eng.), F. S. Dainton, J. P. Keene, and D. C. Walker. Proc. Chem. Soc., 266-7(Aug. 1964).

Studies were made on the effects of increasing pH in the range 7-13, change of medium from H_2O to D_2O, and the addition of various solutes on the species produced in the pulse radiolysis of water. An increase in pH caused an increase in optical density of the electron bond at 700 mμ. If ϵ for the solvated electron is unaffected by change of pH then the upper curve signifies an increase in G_{e^-} of about 35%, with an increase of pH from 10 to 13. There are signs that the electron spectrum in D_2O is shifted to slightly shorter wavelengths compared to that in H_2O, and there is also an increase in $G_{\epsilon_{D_2O}}$ (at 5450 A) of about 20% in changing from natural pD to pD 13. At both pD values the first-order decay of the solvated electron is slower than at the corresponding pH values in H_2O. (P.C.H.)

43664 PRIMARY PROCESSES IN THE PHOTO-OXIDATION OF IODIDE ION IN ETHANOL. G. Dobson and L. I. Grossweiner (Illinois Inst. of Tech., Chicago). Radiation Res., 23: 290-9(Oct. 1964).

Flash photolysis measurements on iodide ion in ethanol show that the initial photochemical products are solvated electrons and iodine atoms in equilibrium with I_2^-. The solvated electrons disappear by a first-order process of 30-μsec life-time in deaerated solutions attributed to a reaction with ethanol. The decay of I_2^- takes place by a fast second-order process. The absence of intermediate I_3^- and the negligible yield of iodine product indicates that the decay of I_2^- is at least partially due to a back-reaction with reduced ethanol. Nitrous oxide scavenges solvated electrons but does not lead to final iodine product. The results are explained by a fast back-reaction of reduced N_2O with I or I_2^-, possibly through an ethanol radical intermediary. Dissolved oxygen scavenges solvated electrons and leads to a permanent iodine product via a nonequilibrium I_3^- intermediary. The kinetic spectrophotometric data indicate that I_2^- is the source of I_3^- and that the predominent effect of oxygen is a suppression of the back-reactions. (auth)

43665 RADIOLYSIS OF 2,2,4-TRIMETHYLPENTANE AND 2,2,4,4-TETRAMETHYLPENTANE. J. A. Knight and C. T. Lewis (Georgia Inst. of Tech., Atlanta). Radiation Res., 23: 319-29(Oct. 1964). (TID-20161)

Two highly branched hydrocarbons, 2,2,4-trimethylpentane and 2,2,4,4-tetramethylpentane, were irradiated with a 12-kc ^{137}Cs source, and the radiolysis products were characterized with gas chromatography. Most of the products in the C_1 to C_9 range were identified, and G values determined. It was not possible to identify products in the C_{10} to C_{18} range because of the lack of authentic hydrocarbon samples. Radiolysis products in the C_{10} to C_{18} range were grouped according to carbon content on the basis of reten-

tion times, and G values were determined. The results indicate that C–C bond fission is an important process and will occur predominantly at the site of greatest branching and that the resulting fragments yield products that can be related structurally to some portion of the parent hydrocarbon. The combination of two fragments of carbon content less than the parent hydrocarbon is a relatively minor process, whereas the combination of fragments one or both of which are formed by a C–H bond fission is of more importance and accounts for the major portion of products of carbon content greater than the parent hydrocarbon. The lack of large quantities of rearranged products, particularly those that might be expected from the neopentyl fragment from 2,2,4,4-tetramethylpentane, is evidence that rearrangement or isomerization processes are relatively unimportant in the radiation chemistry of highly branched hydrocarbons. The G values, except for a few cases, decreased with a decrease in temperature. The yields of hydrogen decreased with a decrease in temperature in the liquid phase but showed an increase for both hydrocarbons in the solid state. The yield of the products which would include the dimers increased with a decrease in temperature. On the basis of the results for 2,2,4-trimethylpentane, free radical processes would account for about 41% of C–C bond fission, and "molecular" processes would account for the other. For C–H bond fission, 36% would be accounted for by free radical processes, and the other by "molecular" processes. It is evident that the molecular processes are of considerable importance in the radiation chemistry of highly branched hydrocarbons. (auth)

43666 CARBOXYLATION OF FORMIC ACID TO OXALIC ACID IN AQUEOUS CARBONIC ACID SOLUTION UNDER THE EFFECTS OF Co^{60} GAMMA RADIATION. F. Guetlbauer and N. Getoff (Institut für Radiumforschung und Kernphysik, Österrichische Akademie der Wissenschaften, Vienna). Radiochim. Acta, 3: 1-6(Oct. 1964). (In German)

The carboxylation process of organic compounds in aqueous solutions of carbon dioxide under the influence of ^{60}Co γ rays was studied in respect to its dependence on the pH, the dose, and intensity of radiation. As a model substance 0.1m formic acid saturated with CO_2 up to a pressure of 1 atm was used. Oxalic acid was obtained as a product of carboxylation. Using a dose of 2×10^{18} ev/ml in the acidic region ($p_H = 2.8$) the initial yield of the formation of oxalic acid was $G(COOH)_2 = 1.8$, whereas in the basic region it rose up to 9.1. The experimental results suggest a chain reaction mechanism to be at least partially responsible for the carboxylation of formic acid to oxalic acid. (auth)

43667 SENSITIZATION OF CROSS-LINKING IN POLYSTYRENE BY AROMATIC ADDITIVES WITH THE ACTION OF IONIZING RADIATION. H. Heusinger (Technische Hochschule, Munich). Radiochim. Acta, 3: 7-13(Oct. 1964). (In German)

When absolutely oxygen-free polystyrene is irradiated, an addition of pyrene increases the crosslink formation between chains. This effect reaches a maximum at 10^{-4} mole pyrene/g polystyrene. It was found that this is no softening effect. Nor can this observation be attributed to insertion of additive molecules as crosslinks into the polymer, as the additive is unchanged after reaction. It is assumed that below the freezing temperature of polystyrene (+80°C) crosslinking does not occur by radical combination, but that the reaction components are excited states. The additional induction of crosslinking could then be understood as an additive sensibilized reaction. (auth)

43668 ON THE MECHANISM OF THE RECOIL PHENOMENA IN HEXAMMINECOBALT(III) CHLORIDE. Nagao Ikeda, Kenji Yoshihara, and Shigeru Yamagishi (Tokyo Kyoiku Univ. and Japan Atomic Energy Research Inst., Tokyo). Radiochim. Acta, 3: 13-18(Oct. 1964).

Recoil phenomena of ^{38}Cl and ^{60}Co produced by the (n,γ)-reaction in solid $[Co(NH_3)_6]Cl_3$ were studied. Several percent of the ^{38}Cl activity was found in the $[Co(NH_3)_5Cl]^{2+}$-form, whereas the greater part of ^{60}Co activity was found in the Co^{2+}-fraction with several percent in the $[Co(NH_3)_5Cl]^{2+}$-form, which indicates the complicated nature of the processes involved in the recoil events. The thermal annealing of ^{38}Cl or ^{60}Co activity in the above-mentioned forms is quite noticeable even at room temperature. The annealing process may be considered to be a chemical reaction. As the range of (n,γ)-recoils is very short, the recoil products would be correlated closely to each other, and this would be responsible for the apparent first-order kinetics in the earlier stage of thermal annealing. (auth)

43669 TRANSFER ANNEALING IN CHROMIC-DOPED POTASSIUM CHROMATE. D. J. Apers, K. E. Collins, C. H. Collins, Y. F. Ghoos, and P. C. Capron (Université, Louvain, Belg.). Radiochim. Acta, 3: 18-20(Oct. 1964).

Thermal treatment on chromic (^{51}Cr)-doped potassium chromate resulted in the incorporation of ^{51}Cr activity into the chromate form. Measurements of the isothermal kinetics of this incorporation gave annealing curves similar to those obtained in Szilard-Chalmers studies on potassium chromate. It was concluded that transfer annealing may play an important role in Szilard-Chalmers annealing processes in potassium chromate. (auth)

43670 ANNEALING OF RECOIL BROMINE-82 IN HEXABROMOETHANE. PART I. INFLUENCE OF LOW CONCENTRATIONS OF CRYSTAL DEFECTS. Kenneth E. Collins and Garman Harbottle (Brookhaven National Lab., Upton, N. Y.). Radiochim. Acta, 3: 21-6(Oct. 1964). (BNL-7756)

The influence of defects produced by gamma radiation exposures of 2 to 1400 R on the subsequent thermal annealing of ^{82}Br in crystalline C_2Br_6 was investigated at annealing temperatures in the range 0 to 120°C. Incorporation of recoil ^{82}Br into C_2Br_6 during annealing occurs by several processes. One process is dependent on radiation dose while the others are independent of dose in the range studied. Doping the crystals with Br_2 affects the annealing at high but not at low temperatures, simulating the effect of a low level of radioinduced defects. The dose-independent annealing is discussed in terms of intra-site reactions occurring in several different kinds of isolated recoil-produced sites. (auth)

43671 RECOIL EFFECTS ENSUING FROM $^{59}Co(n,\gamma)$-^{60}Co AND $^{59}Co(\gamma,n)^{58}Co$ REACTIONS IN OPEN TYPE COBALT COMPLEXES– II. J. Shankar, Amar Nath, and M. H. Rao (Atomic Energy Establishment, Trombay, India). Radiochim. Acta, 3: 26-9(Oct. 1964).

The open-type cobalt complexes are characterized by a small (or zero) magnitude of post-recoil thermal annealing, both for (n,γ) and (γ,n) reactions. In this category of complexes, the stereochemical configurations do not permit efficient interaction with the energetic recoil atom and the excess energy is not dissipated rapidly enough, resulting in collapse of the molecule, and annealable metastable centers are not formed. Vitamin B_{12}, though a hexacoordinated complex, belongs to this category by behavior, while cobalt tetraphenylporphinate behaves differently. Occluded oxygen decreases the magnitude of thermal anneal by virtue

of its being an electron trap, thereby removing the electrons from the sphere of reaction. (auth)

43672 ANNEALING OF RECOIL BROMINE-82 IN HEXABROMOETHANE. PART II. EFFECTS OF DOSE-RATE AND INTEGRATED DOSE ON THERMAL AND RADIATION ANNEALING. Kenneth E. Collins and Garman Harbottle (Brookhaven National Lab., Upton, N. Y.). Radiochim. Acta, 3: 29-35(Oct. 1964). (BNL-7845)

The effect of pre-irradiation of hexabromoethane with gamma rays upon subsequent thermal annealing of recoil bromine-82 was examined: the doses given ranged from 2 to 2×10^7 R. The results reveal a complex pattern, which is discussed in terms of trapped defects having a variety of activation energies for release, and the interaction of the released defects with the recoil atoms. The results of both pre- and post-irradiation (radiation annealing) were found to depend on radiation intensity. In the former case the higher the intensity the greater the effectiveness in promoting annealing while in the latter the reverse was true. (auth)

43673 COMPARATIVE STUDY OF CHEMICAL EFFECTS FOLLOWING THE K CAPTURE (n,p), AND (n,γ) PROCESS. E. Merz and H. J. Riedel (Kernforschungsanlage, Julich, Ger.). Radiochim. Acta, 3: 35-40(Oct. 1964). (In German)

The recoil products formed following the K-capture decay in ^{68}Ge-tetraphenyl were compared with those from the (n,γ)-reaction on Ga-triphenyl and the (n,p)-reaction on Ge-tetraphenyl. It was found that several recoil products of Ga with metalloorganic character were formed in the two nuclear reactions, whereas in the K-capture process on ^{68}Ge-tetraphenyl the ^{68}Ga could be separated almost in the inorganic form. The hypothesis is put forward that no hot reactions take place in the K-capture decay of ^{68}Ge on Ge-tetraphenyl. (auth)

43674 THE CHEMICAL FORMS OF RADIOARSENIC ACTIVATED IN β-DECAY OF $^{77}GeCl_4$ AND IN THE $^{75}AsCl_3$ (n,γ) REACTION IN BENZENE. A. Halpern, K. E. Siekierska, and A. Siuda (Inst. of Nuclear Research, Warsaw). Radiochim. Acta, 3: 40-4(Oct. 1964).

The distribution of radioarsenic among the various products in the presence of oxygen was determined in the following series of experiments: 1M $AsCl_3$ in benzene was activated with thermal neutrons; $^{77}GeCl_4$ was kept in contact with benzene; and $^{77}GeCl_4$ was kept in contact with benzene in the γ field of a ^{60}Co-unit, at two different gamma dose rates. The distribution of the products (labeled with ^{76}As and ^{77}As, respectively) was determined by high-voltage paper electrophoresis. The results show that: the distribution of radioarsenic is not only dependent on the properties of the recoil fragment produced in the nuclear process, but also on the radiation-increased chemical reactivity of the organic environment; both ^{76}As formed in the (n,γ) reaction and ^{77}As produced by β-decay give the same organic yield, however, some changes in the distribution of products were observed; the formation of the products by the hot processess was due mainly to reaction of the recoil atom with a single medium molecule or with its fragmentation products. (auth)

43675 SIMPLE AND RAPID PRODUCTION OF CARRIER-FREE SODIUM-24. W. Parker, H. Bildstein, and N. Getoff (Reactor Center, Seibersdorf, Austria). Radiochim. Acta, 3: 74-6(Oct. 1964).

A simple and rapid method is described for the production of carrier-free sodium-24 following the irradiation of magnesium with fast neutrons according to the nuclear equation: $^{24}Mg(n,p)^{24}Na$. Based on the irradiation of MgO or $Mg(OH)_2$ in the presence of water followed by extraction of ^{24}Na also with water and with a final purification stage, involving ion exchange, the described method should prove very suitable for work at Curie level. Detailed data are given for the pre-purification of the commercial magnesium target material and for its preparation as a slurry so as to take advantage of recoil products produced during the irradiation. Curves and data are presented showing the yield dependence on the water content of the magnesium target and of the efficiency of water as an extraction medium. In conclusion, the final purity of ^{24}Na separated using the described method is discussed. (auth)

43676 PHOTOPRODUCTION OF ^{132}Cs WITH A 20-Mev LINEAR ELECTRON ACCELERATOR. Kichizo Tanaka, Tsutomu Tamura, and Tokihiro Kuroyanagi (Japan Atomic Energy Research Inst., Tokyo). Radiochim. Acta, 3: 87-9 (Oct. 1964).

The routine production of ^{132}Cs was accomplished through utilization of a linear electron accelerator. Processes were developed for the estimation of the yield of ^{132}Cs, the assay of the radiochemical impurities, and the estimation of the spatial distribution of bremsstrahlung by the copper activation method. Ten millicuries of ^{132}Cs were produced per ten hours irradiation period at 20 Mev and 40 μA, and the radiochemical purity of the products was found to be higher than 99.99%. (auth)

43677 RADIOLYSIS OF ICE BY ^{90}Sr β-PARTICLES. Zbigniew Czerwik and Jerzy Kroh (Technical Univ., Lodz, Poland). Roczniki Chem., 38: 1217-19(1964).

The temperature dependence of the $G(Fe^{3+})$ value for ice irradiated with ^{90}Sr β particles was determined. The dependence for ^{90}Sr β particles appears to be linear and may be roughly expressed by the empirical equation: $G(Fe^{3+}) = 0.016T - 0.46$. Several values of $G(Fe^{3+})$ calculated from the equation are tabulated. (P.C.H.)

43678 RADIATION-CHEMICAL OXIDATION OF PEPTIDES IN THE SOLID STATE. Warren M. Garrison, Michael E. Jayko, and Winifred Bennett-Corniea (Univ. of California, Berkeley). Science, 146: 250-2(Oct. 9, 1964).

Gamma irradiation of polypeptides as highly dispersed fluffs under oxygen leads to chemical degradation of the peptide bond with the remarkably high oxygen consumption of about one molecule per 2 ev of absorbed energy. A radical chain mechanism appears to be involved, and there is evidence that excited states of the polypeptide aggregate undergo chemical quenching by molecular oxygen. (auth)

43679 ELECTRON SPIN RESONANCE OF γ-IRRADIATED THIOPHENE-2-CARBOXYLIC ACID. B. Eda, R. J. Cook, and D. H. Whiffen (Government Industrial Research Inst., Nagoya, Japan and National Physical Lab., Teddington, Eng.). Trans. Faraday Soc., 60: 1497-1501(Sept. 1964).

The action of γ rays on thiophene 2-carboxylic acid yielded several free radicals. The most heat-stable radical is shown to be that formed by addition of a hydrogen atom to the carbon at position 5. The hyperfine couplings were determined and, in contrast to the corresponding radical from furoic acid, there was evidence that the ring of the radical is non-planar. (auth)

43680 INVESTIGATIONS OF YIELDS FROM THE $Br^{81}(n,\gamma)Br^{82}$ REACTION IN THE $CH_2Br_2-C_6H_6$ SYSTEM. E. S. Filatov, An. N. Nesmeyanov, and Yu. B. Chepyzhev. Vestn. Mosk. Univ., Ser. II, Khim., No. 6, 45-6(Nov.-Dec. 1963). (In Russian)

Recoil mechanisms in $^{81}Br(n,\gamma)^{82}Br$ reactions in CH_2Br_2–C_6H_6 were studied. The system was irradiated for 4 days using a Po–Be neutron source. The results of column filtration analysis followed by scintillation counting were in agreement with An. Nesmeyanov (Radiokhimiya 3, 5, 614(1961)). It is postulated that the increased yield of $C_2H_5{}^{82}Br$ is related to an excitation energy migration from freshly formed $C_2H_5{}^{82}Br$ molecules and not to diluting effects. The excitation energy was determined from the distance between benzene molecules. The yield of CH_2Br_2, corrected for a simple diluting effect, was plotted as a function of the mean distance between excitation energy acceptor molecules (benzene). The benzene effect on the survival of $CH_2Br_2^*$ molecules begins with 0.74 M benzene or when the CH_2Br_2 molecules are surrounded by an average of 7 benzene molecules. (R.V.J.)

43681 THE EFFECT OF LIGHT ON FREE RADICALS STABILIZED IN γ-IRRADIATED POLYVINYLACETATE AND POLYMETHYLMETHACRYLATE. V. K. Milinchuk and S. Ya. Pshezhetskii (Karpov Inst. of Physics and Chemistry, Moscow). Vysokomolekul. Soedin., 9: 1605-11(1964). (In Russian)

The effect of visible and uv light on free radicals in γ irradiated polyvinylacetate and polymethylmethacrylate at 77°K was investigated. It was found that transformation of the free radicals at the temperature of liquid nitrogen is reversible. It is suggested that dynamic equilibrium exists between isomeric forms of the radicals. (auth)

43682 EXPERIMENTAL MODEL FOR CHEMICAL CARCINOGENESIS AND THE PHOTODYNAMIC EFFECT OF 3,4-BENZOPYRENE AND UV LIGHT IN AQUEOUS PROTEIN SOLUTIONS WITH DIFFERENT SH-GROUP REACTIVITIES. Guenter Reske and Joachim Stauff (Universität, Frankfurt am Main). Z. Naturforsch., 19b; 716-26 (Aug. 1964). (In German)

The carcinogenic hydrocarbon 3,4-benzopyrene is soluble in aqueous solutions of different proteins. The solubilities are easily determined by the fluorimetric method. The fluorescence of the hydrocarbon in the protein solutions is not quenched by molecular oxygen. Nevertheless only in presence of air (oxygen) an irreversible decrease of the fluorescence intensity occurs under irradiation with uv-light of wavelength 366 mμ, which is considerably faster than under nitrogen or in solutions of the hydrocarbon in ethanol or aqueous caffeine. In the systems investigated, a correlation was found between the half-life period of the reaction and the SH-group activities. The participation of protein-SH-groups in the 3,4-benzopyrene photoreaction is demonstrated by amperometric $Ag^{\oplus}$-titrations. The influence of protein denaturation and inhibiting additives on the photoreaction are investigated by the fluorimetric method. Irradiation- and oxygen-dependence of the reaction are analogous to the observations of photodynamic action and skin cancer induction by 3,4-benzopyrene. By 366 mμ irradiation of β-lactoglobuline solutions containing 3,4-benzopyrene the heat-denaturation characteristics of the protein are changed. The same changes are produced without 3,4-benzopyrene by uv-light of the wavelength 280 mμ. Treatment of the β-lactoglobuline solutions with an amount of cigarette smoke, which certainly does not contain 3,4-benzopyrene in sufficient concentration, acts in the same direction. Along with the changes in the protein properties the typical fluorescence of 3,4-benzopyrene vanishes. The hydrocarbon does not act as a catalyst in photodynamic action, but is chemically altered as well as the protein, at least in the system under investigation. (auth)

43683 CONTRIBUTION TO FLUORESCENCE AND ENERGY TRANSFER IN PURE SOLVENTS AND LIQUID MIXTURES OF ORGANIC SCINTILLATORS. Gerhard Hoefer (Universitat, Giessen, Ger.). Z. Physik, 181: 44-57 (1964). (In German)

The intensity and the decay time of pure solvents and mixtures of two different solvents with and without fluorescent molecules were investigated by way of excitation with electron beams and ultraviolet light. In the solutions anthracene–benzene and o,o'-biphenol–benzene the characteristic transfer constant $a = 1/\tau_t \cdot c$ was determined in two different ways. The investigation of the intensity and the decay time of a solution with two solvents in dependence of the ratio of the components at constant concentration of the fluorescent molecules leads to the conclusion, that the energy transfer from solvent to solute via other solvent molecules is insignificant. (auth)

43684 EPR STUDY OF THE FORMATION OF FREE RADICALS IN γ-IRRADIATED AMMONIUM AND HYDRAZINIUM SALTS. A. G. Kotov and S. Ya. Pshezhetskii (Karpov Inst. of Physics and Chemistry, Moscow). Zh. Fiz. Khim., 38: 1920-5(Aug. 1964). (In Russian)

Electron spin resonance spectra of the free radicals formed in γ irradiated ammonium and hydrazinium salts show that in both cases the ion-radicals NH_3^+ and $N_2H_4^+$ are produced. The differences in the hyperfine structure of EPR spectra of a single radical in different salts were ascribed to differences in hyperfine anisotropic interactions. (auth)

43685 REACTIONS OF ENERGETIC CARBON WITH SIMPLE GASEOUS AND LIQUID HYDROCARBONS. G. Stoecklin and A. P. Wolf (Brookhaven National Lab., Upton, N. Y.). p.181-91 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Attempts to label organic compounds with ^{14}C by recoil methods via the $^{14}N(n,p)^{14}C$ process were disappointing in many cases studied. For a mechanistic study the short-lived ^{11}C produced via the $^{12}C(n,2n)^{11}C$, $^{12}C(p,pn)^{11}C$ processes provides a better tool since it offers greater flexibility in irradiation conditions and less radiation damage. The effect of phase, scavenger, and structure was studied in a great variety of simple hydrocarbons. Insertion reactions of carbon and its secondary species seemed to provide a reasonably consistent overall picture. The assumption of a collision complex formation and its subsequent de-excitation or decay was also consistent with what is known to date. A change from the gas to the liquid phase (where stabilization is favored) led to a decrease of the fragmentation products (acetylene and ethylene) accompanied by an increase in the stabilization products (hydrocarbons with one more C atom than the substrate). The formation of the various higher hydrocarbons was statistical in the liquid phase. Acetylene and ethylene were the major products in all aliphatic hydrocarbons studied. The acetylene yield was proportional to the relative number of CH_3 groups in the molecule; the ethylene yield was directly proportional to the relative number of primary C—H bonds. Structure and deuterium isotope effects suggested that acetylene is formed via carbon and ethylene via methyne insertion reactions. Kinetic studies of competition reactions in binary systems gave additional information on the relative rate constants for the reactions of energetic carbon. (auth)

43686 RADIATION DECOMPOSITION OF SOLID AMINO ACIDS. B. M. Tolbert, R. Stansfield, and Marie H.

Krinks (Univ. of Colorado, Boulder). p.575-81 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Radiation stability of amino acids is discussed. The decarboxylation process was found to be important and data are presented for several amino acids. Decomposition and decarboxylation were combined with ESR (electron spin resonance) yield data to give a postulated decomposition mechanism. Specific decomposition pathways for dl-leucine are then presented together with yields for various products. The problem of variable decomposition values in solid state studies is reviewed. (auth)

43687 SELF-DECOMPOSITION OF ^{14}C-LABELLED SUGARS. G. O. Phillips and K. W. Davies (University Coll., Cardiff, Wales). p.619-28 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

The number of products formed during self-decomposition of D-[^{14}C] glucose and D-[^{14}C] sorbitol greatly exceeds the number formed when these sugars are degraded with γ irradiation in aqueous solution at similar low conversions. To establish the fraction of the emitted energy absorbed by the sample during storage, standardized quantities were stored under reproducible conditions on glass slides on filter paper at −15 and +26°C. Isotope dilution and paper chromatographic techniques were used to measure the rate of decomposition during 13, 28, 45, and 57 weeks storage. The results indicated that direct action effects contribute chiefly to the self-decomposition. For D-[^{14}C] glucose G(M) was 26 to 29, which was consistent with observations on the decomposition of D-glucose in the solid state. Previously, secondary effects due to reactive species formed by radiolysis of non-bonded water were believed to be the dominating processes. A fundamental objection to this conclusion is the high G(M) values observed, which does not apply to the direct action processes that are postulated. (auth)

43688 RADIATION CHEMISTRY OF AMINO ACIDS AND PROTEINS. B. M. Tolbert, Marie H. Krinks, and Cl. O. Stevens (Univ. of Colorado, Boulder). p.671-98 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Direct chemical effects of radiation on amino acids were studied. It was concluded that the number of initial molecules undergoing decomposition must be about 3 to 6 per 100 ev. Amino acids with a high charge to size ratio were found to be the most stable. Radiation effects on amino acids in aqueous solutions were also determined. Radiation effects on proteins in dry solid preparations were studied and the loss of enzymic activity as a function of dose was generally exponential. High temperature and the presence of oxygen increased the radioinduced inactivation of enzymes. The inactivation of a given enzyme in solution was independent of concentration over a wide range except in very dilute solutions when the inactivation yield fell with decreasing protein concentration. (M.C.G.)

43689 RADIOCHEMICAL METHODS OF MARKING ORGANIC MOLECULES. W. Herr (Universität, Cologne and Kernforschungsanlage, Julich, Ger.). p.885-904 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

The following radiochemical methods of labeling organic compounds are described and compared: radioactive recoil, exchange reactions, reactions via accelerated radioactive ions, and radioinduced reactions. (M.C.G.)

43690 SYNTHESIS OF 1-METHYL-9, 10-DIHYDRO-^{3}H-LYSERGAMIDE AND PREPARATION OF ^{3}H-LABELLED STEROIDS BY EXCHANGE REACTION. M. Dubini (Istituto Richerche "G. Donegani," Novara, Italy). p.911-14 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

The introduction of ^{3}H in the lysergic acid is described. The dihydro-^{3}H-lysergic acid obtained was transformed into 1-methyl-dihydro-^{3}H-lysergamid. Observations were made on purification of the product. Exchange reactions between ^{3}H and 6-α-methyl-17-α-hydroxy progesterone and 4-hydroxy-17-α-methyl testosterone are also described. The convenience of accelerating the tritium exchange with ultraviolet irradiation is questioned. (auth)

43691 AUTO-RADIOLYSIS OF HIGH-SPECIFIC-ACTIVITY TRITIUM-LABELLED STEROIDS. P. A. Osinski and J. M. Deconinck (Universite Catholitque, Louvain, Belg. and Universitaires St-Pierre, Louvain, Belg.). p.931-8 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

A study was made of self-irradiation destruction of tritiated steroids. The variables investigated were: molecular structure, specific activity, time, temperature, solvent, and the presence of oxygen. The technique used was to measure the intact substance and its radiolytic products by quantitative scanning of the radioactivity on paper chromatograms. The results showed that the principal factors affecting radiolytic processes are the structure of the molecule, temperature, and solvent. The optimal conservation procedure was investigated for a number of adrenal steroids. Some theoretical hypothesis are proposed concerning the mechanism of radiolysis by soft β particles. Preliminary results are presented on the structure and properties of the radiolysis products. (auth)

43692 SELF-DECOMPOSITION OF TRITIATED THYMIDINE IN AQUEOUS SOLUTION: ACTION OF TEMPERATURE AND OF A PROTECTIVE AGENT (CYSTEAMINE). Sonia Apelgot, B. Ekert, and Marie-Renée Tisné (Institut du Radium, Paris). p.939-52 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

The self-decomposition of tritiated thymidine is being studied using a 5×10^{-4}M aqueous solution, with a specific activity of 9 C/mmole. The reaction was examined by paper chromatography, using three different solvents; the radiochromatograms were quantitatively analyzed. Results were obtained at three temperatures: 0, −20, and −75°C. Both in the presence and in the absence of cysteamine, it is shown that the percentage decomposition at −20°C is greater than at 0°C and at −75°C. At 0°C and −75°C the percentage decomposition was the same. For a given temperature and dose, decomposition was markedly diminished in the presence of cysteamine. (auth)

43693 AUTORADIOLYTIC DECOMPOSITION AND METHODS FOR STORAGE OF TRITIATED COMPOUNDS. A Guarino (Università, Rome). p.1059-70 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

A major problem in the use of high-specific-activity radioactive compounds is due to the fact that radioactive impurities are produced in initially pure samples during their storage, owing to their autoradiolytic decomposition. Studies were made of the following compounds labeled with ^{3}H at high levels of specific activity: cyclohexane, n-propanol, phenylalanine, methyl stearate, and methyl butyrate. The

labeled compounds were stored under different conditions (under vacuum, in benzenic solution, absorbed into different inert support, etc.). In all the experiments, the percentage of the starting material decomposed was measured: in addition, the type and amount of the radioactive impurities produced from a given compound stored under different conditions were determined. Storage techniques involving a substantial decrease in autoradiolytic decomposition of the labeled products are discussed. (auth)

43694 STABILITY OF TRITIATED LYSOZYME AND RIBONUCLEASE. W. Baeyens, G. Zamorani, and L. Ledoux (Studiecentrum voor Kernenergie, Mol. Belg.). p.1191-1202 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

Lysozyme, isolated from egg white, was tritium labeled by the Wilzbach method, chromatographically purified on a column of carboxymethylcellulose, and lyophilized. A 5 mg/ml solution was then distributed over a number of fractions of about 100 μl, which were kept in a frozen state. Enzymatic and chromatographic analyses were periodically carried out on one of the fractions. The enzymatic activity and the specific radioactivity were determined. Whereas the enzymatic activity remained virtually constant, the specific radioactivity showed spasmodic fluctuations. These long-term fluctuations in the specific radioactivity of tritium-labeled lysozyme were considered to be caused by an unstable radioactive component, which did not show up positively either in the ultraviolet zone of the egg whites or with the Folin reagent, but was in the course of time eluted together with lysozyme. If the molecules thus labeled were examined shortly after tritium labeling, these fluctuations appeared to have no appreciable influence. After five successive chromatographic analyses, a much less pronounced and more regular decrease of the specific activity was observed. However, the examination of labeled lysozyme, which was kept frozen for several months, showed that care must be exercised when assessing the stability of the specific activity. The stability of tritiated ribonuclease was also investigated. (auth)

43695 THE TRITIUM ISOTOPE EFFECT IN PYRIMIDINES. L. Traeger, A. Kornhauser, and A. Wacker (Universität, Frankfurt am Main). p.1217-21 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

After uv irradiation pyrimidine bases of nucleic acids form photoproducts. For detailed research of these compounds tritium-labeled uracil was used. Uracil formed the photoproducts uracil dimer and uracil water addition product (5,6-dihydro-6-hydroxy-uracil) in a quantity that depended on the radiation dose. The specific radioactivity of the dimer and of the nonreacted uracil depended only little on dose. However there was a large isotopic effect at the formation of the water addition product of uracil at small doses and 42% of the tritium was accumulated. At the end of the photo-reaction the tritium-content decreased to 15% above the normal level. By conversion of the water addition product to uracil (heating for 1 hr at 100°) only a small loss of tritium could be observed. If the isotopic effect did not exist, the loss of tritium should amount to 50%. After conversion of the uracil dimer to uracil (by uv irradiation for 15 min) no loss of tritium was observed. Uracil formed by heating the water addition product contained tritium not equally distributed among the positions 5 and 6. In the presence of tritium-water only very small activities were incorporated into the photoproducts of uracil. By conversion of the photoproducts to uracil or by bromination to 5-bromo-uracil, it was found that the water addition or elimination of the water molecule are not stereospecific. It was also concluded that the hydroxy-group in the water addition product really is bounded to C-6 in uracil. When 5,6-tritium-labeled pyrimidines were incubated with hot concentrated acids, the tritium-content in position 5 decreased, while in other reactions this position was stable. (auth)

43696 ON THE MECHANISM OF LABELLED COMPOUND SYNTHESIS USING THE FISSION OF URANIUM. F. Baumgaertner and A. Schoen (Technischen Hochschule, Munich). p.1331-8 of "Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules," EUR-1625.e.

After the fission of uranium in a powder mixture of ferrocene and U_3O_8, the formation of ruthenocene-(^{103}Ru) was observed: $U(n,f)^{103}Ru + Fe(C_5H_5)_2 \rightarrow {}^{103}Ru(C_5H_5)_2$. At a molecule ratio of uranium: ferrocen = 4:100 the yield of carrier-free ruthenocene was about 25%. Iodine-ferrocene-(^{131}I) was formed with equally good yields: $U(n,f)^{131}I + Fe(C_5H_5)_2 \rightarrow (C_5H_5)Fe(C_5H_4{}^{131}I)$. In the same way, and with equally high yields, the homologous compound $^{99}Mo(CO)_6$ was obtained by neutron irradiation of a mixture of U_3O_8 and $Cr(CO)_6$: $U(n,f)^{99}Mo + Cr(CO)_6 \rightarrow {}^{99}Mo(CO)_6$. Chemically sensitive compounds such as the easily oxidized $Mo(C_6H_6)_2$ were also formed under these conditions: $U(n,f)^{99}Mo + Cr(C_6H_6)_2 \rightarrow {}^{99}Mo(C_6H_6)_2$. This synthesis was carried out in a vacuum. Dibenzol technetium, which is isoelectronic to dibenzol chromium, was also obtained this way: $U(n,f)^{99m}Tc + Cr(C_6H_6)_2 \rightarrow {}^{99m}Tc(C_6H_6)_2$. When uranium was split in the presence of iodobenzene and α- or β-iodonaphthalene, about 90% of the organically bound ^{131}I atoms reappeared in molecules of the original configuration, despite the numerous possible diiodine compounds. Tests on the mechanism of these labeling reactions showed that they are caused by the reactivity of the secondary fission products during the formation process. (auth)

43697 RADIATSIONNYE EFFEKTY V KONDENSIROVANNYKH SREDAKH. (Radiation Effects in Condensed Media). Yu. I. Talanin, ed. Tashkent, Publishing House of the Sciences, 1964. 147p.

Twenty-two papers on radiation effects in condensed media are presented. Separate abstracts were prepared for each paper. (M.C.G.)

For abstracts of individual papers see: 43427, 43428, 43429, 43430, 43431, 43432, 43433, 43434, 43435, 43436, 43698, 43699, 43700, 43701, 43702, 43703, 43704, 43705, 43825, 43826, 43991, and 44276.

43698 EFFECTS OF TEMPERATURE CONDITIONS DURING IRRADIATION AND ILLUMINATION ON THE ABSORPTION SPECTRA OF CRYSTALLINE QUARTZ. Sh. A. Vakhidov and O. Akhmedzhanov. p.5-8 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Natural and synthetic quartz turn black on irradiation. The absorption spectrum shows maxima at 630 (A_1-band), 460 (A_2-band), 215 (C-band) 173 (D-band), and 163 mμ (E-band observed only with neutron irradiation). These absorption bands are completely annealed out on heating the sample to 500°C. The removal of the dark color in artificial quartz is accompanied by thermal emission, but this effect is not observed with natural quartz. Irradiation of the darkened artificial quartz with ultraviolet light gives a noticeable decolorization of the sample, while the de-

colorization of the natural darkened quartz sample is negligible. On irradiating crystalline quartz with γ rays at 190°C, a darkened quartz having the properties of natural darkened quartz was obtained. These samples were thermally stable, and did not show any thermal emission during thermal annealing and ultraviolet irradiation. The absorption spectrum was identical to the absorption spectrum of natural irradiation-darkened quartz. It is believed that the electrons in the D-band are activated by γ-irradiation at higher temperature, and go directly to the ground state without emission of radiation on deactivation. On the other hand, the artificial darkened quartz involves less energetic capture levels, and thermal emission is observed on decolorizing the quartz. (TTT)

43699 EFFECTS OF ELECTRICAL TREATMENT ON THE ABSORPTION SPECTRUM OF CRYSTALLINE QUARTZ. S. V. Starodubtsev, Sh. A. Vakhidov, and B. Kaipov. p.9-11 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Germanium-activated quartz turns a dark color when subjected to ionizing radiation, and thermoluminesces over a wide region of temperatures from 77 to 680°K. Previous electrical treatment of the quartz with graphite prevents the quartz crystals from turning a dark color under irradiation. An absorption band with a maximum at 290 mμ is observed on subjecting the crystals to ionizing radiation. This band occurs primarily at the pyramid of a positive rhombohedron. Different growth faces of synthetic quartz, which were distinguished by differences in refractive indices and in absorption spectra, were subjected to electrical treatment with graphite or sodium chloride, and then were irradiated, using a ^{60}Co γ source, for 15 minutes at a dose rate of 260 r/sec. The absorption maximum at 290 mμ vanished, just as the maxima at 630, 465, and 215 mμ vanished in natural quartz after electrical treatment with graphite or NaCl. Germanium and sodium impurities in the quartz lattice had an effect on the formation of color centers responsible for the absorption band with a maximum at 290 mμ. (TTT)

43700 EFFECTS OF ELECTRIC TREATMENT ON THE LUMINESCENCE INDUCED BY PROTONS IN CRYSTALLINE QUARTZ. M. Yunusov. p.12-16 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Samples of radiation-darkened quartz 1.6 × 1 × 0.15 to 0.3 cm were polished and subjected to electrical treatment at a temperature of 500°C and a voltage of 2400 volts/cm along the principal optical axis. The quartz samples were ground to a thickness of 200 to 250 μ on a cathode side (from the anode side on part of the samples), and the unpolished side was then irradiated with 80 kev protons. The change in thermoluminescence was determined after electrical treatment. The photocurrent maximum I remained essentially unchanged, and was not sensitive to the duration of the electrical treatment. Maxima III and IV merged into a single, intense maximum. Maximum I was associated with the breakdown of the crystal structure of quartz by the proton bombardment. The centers responsible for the thermoluminescence maxima III and IV were negative ions or vacancies surrounded by holes (it was considered probable that these were type E centers). These ions were displaced in the direction of the anode on application of an external field, and the layer in the vicinity of the cathode became depleted so that the maxima III and IV were considerably depressed. (TTT)

43701 ELECTRON PARAMAGNETIC RESONANCE METHOD OF STUDYING GAMMA ABSORPTION EFFECTS IN SILICA GELS. S. V. Starodubtsev, Sh. A. Abelyaev, and V. P. Chirva. p.17-22 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Samples of silica gel (98.1% SiO_2) were subjected to a thermal treatment in vacuum at a temperature of 350°C for a period of 8 hours. One series of samples was sealed off at an air pressure of 10^{-2} mm Hg std, and another at an air pressure of 10^{-5} mm Hg std. The samples were subjected to irradiation by γ rays at a dose rate of 5×10^5 r/hr. EPR (electron paramagnetic resonance) spectra were taken, and it was possible to plot the irradiation dose as a function of the amplitude of the EPR line, which is proportional to the concentration of defects in the sample. The concentration of paramagnetic defects at first increased linearly with increasing irradiation dose, until finally saturation set in at 7 to 8 Mr for the silica samples under an air pressure of 10^{-2} mm Hg std, and at 15 and 17 Mr for the silica samples under a pressure of 10^{-5} mm Hg std. The concentration of defects was significantly higher in the samples irradiated at 10^{-5} mm Hg std than it was in the samples irradiated at 10^{-2} mm Hg std pressure. The radiation defects in the sample irradiated at 10^{-2} mm Hg std pressure were annihilated on heating the sample to 250 to 300°C, but the sample irradiated at 10^{-5} mm Hg std pressure still showed the presence of paramagnetic centers after a brief heating at 420°C. A prolonged thermal treatment was required to remove the radiation defects from the latter sample. (TTT)

43702 MASS-SPECTROMETRIC STUDIES OF DESORPTION AND ADSORPTION GAS MIXTURES ON THE SURFACE OF IRRADIATED AND NON-IRRADIATED SYNTHETIC ZEOLITES. S. V. Starodubtsev, Sh. A. Ablyaev, U. U. Pulatov, and U. Kh. Rasulev. p.23-9 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

A mass spectrometer was used to follow the kinetics of the absorption and desorption of oxygen, nitrogen, and mixtures of these two gases on the surface of irradiated and unirradiated CaA5 Å zeolite samples. Absorption was carried out at a temperature of –196°C, and desorption was observed on gradually raising the temperature up to 400°C. Nitrogen was absorbed more strongly than oxygen on the unirradiated sample, but oxygen absorbed better than nitrogen on the irradiated zeolite. Most of the nitrogen and oxygen was desorbed from the surface of the unirradiated zeolite at temperatures of –60 and –100° respectively. The desorption at higher temperatures was small for both gases. Irradiation of the zeolite resulted in a shift of the desorption maxima of both oxygen and nitrogen towards higher temperatures. Significant desorption from the irradiated zeolite at higher temperatures was observed for both gases. The evolution of CO_2 and CO from the zeolite surface was observed at temperatures above 350 to 400°C. (TTT)

43703 GAMMA ADSORPTION EFFECTS IN SILICA GEL. Sh. A. Ablyaev. p.30-43 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

The ability of an irradiated zeolite or silica gel to absorb gases increases with increasing radiation dose, and reaches a saturation limit at 1.5 to 2.0 million R dose. An attempt was made to derive a mathematical theory explaining the experimental facts. On irradiating a silica gel with 1.25-Mev ^{60}Co γ rays, fast electrons were formed as

a result of Compton scattering. The number of atom displacements (defects) formed as a result of collisions of the atoms with Compton electrons was estimated. A large number of radiation defects, which behaved like new adsorption centers, were formed in this way. These radiation defects were annealed out at a rate that depended on the total irradiation dose. Thus, if the temperature of the silica gel was increased, the vacancies and interstitial atoms became mobile and annihilated each other. At high radiation doses, a saturation effect appeared because the number of radiation defects formed in the silica gel was balanced by the number of radiation defects that disappeared because of the annealing out of the radiation defects. A formula is given that estimates the number of radiation defects formed. (TTT)

43704 INVESTIGATIONS OF HEAT CONDUCTIVITY OF PARAFFIN IN A STRONG GAMMA RADIATION FIELD. R. A. Akbaev, B. S. Mazitov, and S. Z. Pashinskii. p.44-8 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

The thermal conductivity of liquid paraffin was determined in a γ field of 100 to 355 R/sec by measuring, simultaneously, the temperature increase of an internal copper cylinder with time and the temperature difference between an outer vessel and the internal copper cylinder when the gap between the two vessels is filled with paraffin or with air. Corrections were applied because of radiation heating of the paraffin by penetrating ^{60}Co γ rays. The results showed that the thermal conductivity of liquid paraffin increased by 4.9% at a dose rate of 100 R/sec, and by 10% at a dose rate of 250 R/sec, as compared to the thermal conductivity with no radiation present. (TTT)

43705 STUDIES OF RADIATION DESTRUCTION OF CELLULOSE FIBERS IN THE PRESENCE OF GRAFT INHIBITORS. G. A. Klein and M. P. Tikomolova. p.84-8 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

Cellulose fiber regenerated from a xanthate solution was irradiated with ^{60}Co γ rays in glass ampoules under air and under argon. Free radicals should be found in the wood fibers as a result of the γ-irradiation. The primary radicals break down further with disruption of the main chain. If the primary radical is stabilized by reacting with a graft monomer such as α-methylstyrol or benzoquinone, the radiation destruction of the wood fiber is slowed down. To test this hypothesis, samples of wood fiber were irradiated in methanol, which was a good wetting agent for the wood fiber, in 5, 10, and 25% solutions of α-methylstyrol in methanol, and in a 5% solution of n-benzoquinone in methanol at doses of 0.6, 1, and 2 R. The degree of polymerization of the wood fiber was determined by determining the viscosity of the wood fiber in an alkaline solution of ferric tartrate. The copper number was also determined. The results showed that the presence of the graft monomers has an inhibiting effect on the destruction of the wood fiber. (TTT)

Separation Processes and Procedures

Refer also to abstracts 43750 and 44011.

43706 (ANL-6800(p.197-296)) FUEL-CYCLE APPLICATIONS OF VOLATILITY AND FLUIDIZATION TECHNIQUES. (Argonne National Lab., Ill.).

Fluid-bed fluoride volatility processes are being developed for the recovery of U and Pu from spent nuclear fuels. High density UO_2 pellets, clad in either Zircaloy or stainless steel, are typical of the power reactor fuels which can be processed by this means. Laboratory support work for the fluid-bed fluoride volatility processes is continuing with a study of the fluid-bed fluorination of $U_3O_8-PuO_2$ mixtures. This study is directed toward determining the reaction conditions and procedures which would result in a high degree of removal of UF_6 and Pu_6 from the alumina fluid bed. Mixtures of U_3O_8 and PuO_2 are being used in this work to represent the product which is formed by the oxidation of UO_2-PuO_2 fuel pellets. The $U_3O_8-PuO_2$ powder, mixed with alumina, is carried into the alumina bed in the fluidizing N_2 stream at a rate of 3 to 6 g of $U_3O_8-PuO_2$ per minute. F_2 is brought into the bed just above the point at which the $U_3O_8-PuO_2$ powder enters and the fluorination reaction occurs as they mix. In the initial experiments the effect of the presence of fission product oxides in the $U_3O_8-PuO_2$ mixtures on the retention of U and Pu on the alumina fluid bed was investigated. The $U_3O_8-PuO_2$ mixtures contained about 84 wt % U and 0.4 wt % Pu, and the fission products, when present, comprised about 0.9 wt % of the mixture. Experiments were performed in which the $U_3O_8-PuO_2$ was fed into the bed at 500°C and 20 vol % F_2 was used as the fluorinating agent; this was followed by a 5 hr recycle-fluorination period at 500°C using 100% F_2. In these experiments, the presence of fission product oxides did not materially change the U content of the alumina, however, the concentration of Pu retained on the alumina increased from a value of 0.033 wt % in experiments in which fission products were not present to a value of 0.057 wt % in experiments in which fission products were present. An experiment was performed in which the temperature during the $U_3O_8-PuO_2$ feeding-fluorination period was 450°C. This was then followed by recycle-fluorination periods of five hours at 450°C, 5 hr at 500°C, and 10 hr at 550°C. The Pu concentration on the alumina was 0.007 wt %. A means of analyzing PuF_6 in UF_6 will be required in laboratory and pilot plant investigations of problems associated with the fluid-bed fluoride volatility processes. In typical experiments performed on the fluorination of mixtures of U_3O_8 and PuO_2 in the $1\frac{1}{2}$ inch laboratory fluid-bed reactor, the effluent contains about 350 g UF_6 and about 1.4 g of PuF_6. Traps cooled to −80°C are used to remove the UF_6 and PuF_6 from N_2-F_2 stream. A method is being developed to separate the Pu from the bulk of the UF_6 and leave the Pu in a form which can be readily dissolved in aqueous media. Plutonium hexafluoride is reduced by SF_4 while UF_6 is not. Several mixtures containing about 0.5 wt % PuF_6 in UF_6 were made which were each reacted with SF_4 in order to determine the optimum reaction conditions for PuF_6 reduction. A 1.90 stoichiometric excess of SF_4 heated for 22 hours resulted in 100 ± 2% Pu recovery. A study of the decomposition of PuF_6 by gamma radiation in the presence of Kr was completed. A pronounced enhancement of the decomposition of PuF_6 occurs at an exposure dose of 1×10^8 rads when the addition of Kr to PuF_6 is such that the fraction of electrons contributed by Kr is between 0.65 and 0.75. At an electron fraction of 0.73 for Kr, the G value is 19 (based on energy absorbed in PuF_6 alone), whereas it is 7.5 for PuF_6 alone. When the exposure doses were increased to 2×10^8 rads, no increase in G values with increasing electron fractions of Kr were observed; instead, there was a steady decrease in the G value with increased values of the electron fraction of Kr. A study of the factors influencing the rate of

alpha decomposition of PuF_6 is in progress to provide information useful to the fluid-bed fluoride volatility processes. Experiments were carried out in prefluorinated Ni spheres having volumes of 127 ± 2 cm^3. PuF_6 at 100 mm pressure at 26 ± 2°C was introduced into the spheres where it was held for various times. The undecomposed PuF_6 and the F_2 were then removed from the nonvolatile PuF_4. The average rate of PuF_6 decomposition for each decomposition time was calculated from the weight of PuF_4. The rate of PuF_6 decomposition during a 75-day decomposition period was determined to be 0.19 ± 0.03% per day as the average result of 11 experiments. Further rate decreases were observed in experiments of longer decomposition times. No significant difference was observed in the rate of decomposition when the initial pressures of PuF_6 were 50 mm and 100 mm at 26 ± 2°C for a 229-day decomposition period. The presence of PuF_4 at the beginning of the decomposition decreased the decomposition rate of PuF_6 to 0.14% PuF_6 per day from 0.19% PuF_6 per day for pure PuF_6 (no PuF_4 present initially) when the initial PuF_6 pressure was 100 mm Hg and the duration of the decomposition was 75 days. When F_2 was added to initially pure PuF_6 at 100 mm Hg pressure, the PuF_6 decomposition rate for three different experiments decreased to values between 0.054 and 0.13% per day for 75 days of decomposition. O_2 also decreased the PuF_6 decomposition rate. He at 680 mm and 2230 mm partial pressures and Kr at a partial pressure of 3720 mm had little effect on the PuF_6 decomposition rate. High PuF_6 decomposition rates were found in PuF_6–N_2 mixtures and are due to a slow reaction which produces NF_3 and PuF_4. Samples of alloys of Al and Ti were tested for stress-corrosion in an atmosphere of PuF_6. Four samples of 7075 Al alloy were stressed to 61,000 ± 600 psi and two samples of B-120 VCA Ti alloy were stressed to 140,000 ± 1,100 psi. The stressed samples were placed in a quartz vessel, and the PuF_6 (52 mm Hg) was added. The temperature of the quartz vessel was held at 28°C for 15 hr after which the temperature was increased to 65 ± 3°C. At some time between three days and 5¾ days, the two Ti samples ruptured. The vessel was maintained at 65 ± 3°C for 30 days. At the end of this time and an additional 14 days at 25 ± 2°C, the Al alloy samples were still intact. Work on the evaluation of the two-zone oxidation-fluorination technique for the processing of stainless steel-clad UO_2 pellets was continued. In this scheme, the UO_2 pellets are oxidized in a fluidized-packed bed, the oxidation taking place through openings at the ends or in the sides of short segments of the cladding. The oxidation results in the formation of U_3O_8 powder, which is then fluorinated to UF_6. Chopped, clad fuel rods were simulated by placing 0.42-in.-dia. × 0.42-in.-long cylindrical UO_2 pellets inside 15/16-in. lengths of type 304 stainless steel tubing. In one run, in which these segments were used to form a 3-in.-deep fluidized-packed bed, 87% of the U charge was removed from the cladding in 12 hr. The oxidation was carried out at 400 and 500°C with 88% O_2 in N_2. The remaining U was removed by recycle fluorination at 500°C with 64% F_2 in N_2. The separation of UO_2 fuel from stainless steel-clad fuel elements was also studied in experiments in which only oxidation (no fluorination) was carried out in a fluidized-packed bed. In this process, short segments of chopped fuel rods were simulated by inserting UO_2 fuel pellets into pieces of stainless steel (type 304) cladding. Separation of the fuel material from the cladding was accomplished in these experiments by reacting the exposed UO_2 with air at a temperature of about 450°C to form U_3O_8 powder. The air also served to fluidize the alumina grain in the voids of the packed bed of fuel segments. This oxidation technique resulted in a separation of UO_2 from cladding of approximately 95% by using mechanical vibration applied internally to the fuel segments and by the use of gas-pulsing of the fluidized-packed bed. An engineering-scale high-alpha facility is being built to study process steps in the fluid-bed fluoride volatility process for the recovery of Pu and U from spent PuO_2–UO_2 fuel. A program investigating the cleanup of exhaust air from alpha facilities used in fluoride volatility work is in progress. In hydrolysis experiments, UF_6 was diluted with dry N_2 before mixing with moist N_2. Under these conditions of release, the hydrolysis reaction is not as rapid as with release of pure hexafluoride into moist N_2, and the reaction is found to occur primarily on solid surfaces instead of in the gas phase. These experiments showed that, when hydrolysis is not complete, a large percentage of the released U can pass through a high-efficiency filter. A study was made of heat conduction in the lateral direction in fluidized-packed beds in order to gain further information on heat transfer in certain fluidized-bed systems. It was found that the effective thermal conductivities could be correlated by the equation: $(k_e/\rho C_p) = (0.0075)\,[0.0558\, D_p\, (V - V_{mf})/V_{mf}]$ ft/sec where k_e = effective bed thermal conductivity, Btu/(sec)(sq ft)(°F/ft), ρ = density of fluidized particle, lb/ft^3, C_p = fluidized particle heat capacity, Btu/(lb)(°F), D_p = diameter of fixed packing, ft, V = fluidizing gas velocity corrected for packing void fraction, ft/sec, and V_{mf} = minimum fluidization gas velocity corrected for packing void fraction, ft/sec. A study was carried out to determine the characteristics of the longitudinal (axial) movement of particulate solids in fluidized-packed bed reactors. The study is important to the understanding of the two-zone, oxidation-fluorination process for UO_2 pellets, since longitudinal transport of particulate solids (both the fluidized alumina bed and the U_3O_8 fines) occurs during processing. Significant results from these solid transport studies which can be used for the design of fluidized-packed bed reactors are as follows: (1) The rates of mixing with mixtures of −100 + 120 mesh Cu and Ni particles were higher than those with either the larger (−40 + 50 mesh) or smaller (−140 + 170 mesh) particle size mixtures. (2) With increasing gas flow, the longitudinal mixing diffusivities increased to a maximum and then dropped off. For a fixed bed of ⅜-in.-dia. steel spheres and after correcting the gas velocity for packing voidage, the maximum diffusivities for −140 +170, −100 +120, and −40 +50 mesh Cu–Ni mixtures were, respectively, 12.6×10^{-3} ft^2/sec at a gas velocity of 1.5 ft/sec, 17.5×10^{-3} ft/sec, and 9.2×10^{-3} ft^2/sec at 4.2 ft/sec. In these tests, the bed height (static) of the fluidized mixtures was 24 in. (3) Mixing rates increased by a factor of 3.5 as the height (static) of the fluid bed was increased from 8 to 24 in. (4) The solids mixing diffusivities for open tube fluidization (no packing) and for fluidization in the voids of ½-in.-dia. spheres were, respectively, about 140 and 1.7 times as great as the mixing diffusivities for fluidization in the voids of ⅜-in.-dia. spheres. (5) In several tests which were carried out to determine the effect of void structure in the fixed bed, diffusivities obtained with a −100 +120 mesh Cu–Ni mixture fluidized in the voids of several random-packed beds of ⅜-in.-dia. spheres varied by less than a factor of 2. (6) To avoid accumulations of oxide fines in the lower (oxidation) zone of a two-zone, oxidation-

fluorination reactor, the oxidation rate should not be allowed to exceed the fines transport rate. Development of a fluid-bed volatility process for the recovery of U from highly enriched U-alloy fuels is continuing. The process scheme involves a hydrochlorination step which effects volatilization and removal of the cladding and alloying material, and a fluorination step to recover the U as the hexafluoride. Results of studies showed that sintered alumina rather than fused alumina, is suitable both as a fluid-bed and packed-bed filter material and it was found that varying the depth of the packed-bed filter in the range 6 to 12 in. had an effect on the quantity of U lost during hydrochlorination of Al-based fuels. An acceptable loss, about 0.1% of the U in the initial charge, was obtained only when the bed depths were greater than 9 in.; in contrast, only a 6-in. depth was required in the case of Zircaloy-based fuels. Shakedown tests in the pilot plant that has been installed to demonstrate the fluid-bed volatility process for enriched U-alloy fuels indicate that satisfactory operation of the pilot plant can be expected. In the current experiments, all of the equipment involved in the hydrochlorination and hydrofluorination steps was operated. The fluid-bed hydrolysis reactor, which is an integral part of the pilot plant, was operated at 375 and 330°C during the Zircaloy and Al experiments, respectively. Sand was used as a starting bed material in the runs with Zircaloy, and alumina was used as the bed material in the run with Al. Very little deposition of the product oxide on the surface of the starting bed material was noted, particularly during the Zircaloy runs, the bulk of the material being converted to fines (−230 mesh). Bench-scale equipment was fabricated for a high-activity-level study of the fluid-bed volatility process for highly enriched U-alloy fuels. Corrosion studies aimed primarily at the evaluation of Ni as a material of construction for the fluid-bed volatility processes are in progress. Several types of welded and nonwelded specimens are being subjected to simulated process conditions of reactant concentrations and temperatures. Corrosion tests involving flow of F_2 through Ni filter media at 400°C are also in progress. Studies were continued on a fluid-bed process for the preparation of high-density, spheroidal particles of UO_2 directly from UF_6. The process involves reaction of the hexafluoride with a mixture of steam and H_2 in the presence of a product oxide bed. Current studies were made with the filter vessel surmounting the fluid-bed zone. With the new arrangement, fines were returned directly to the bed upon blowback of the filters. Results of work showed that the productivity of the system could be increased without sacrifice of product quality by employment of deeper beds. A hexafluoride feed rate of 50 g/min and a 17-in. bed height (static) gave a product with a higher density than the same feed rate with a 9-in. bed, the corresponding density values being 9.1 and 8.8 g/cc. Preparation of dense UO_2 particles in a smaller size range than those made previously was demonstrated. Starting with a 3.7-kg bed of −170 +325 mesh particles having a density of 8.6 g/cc, a product having over 50% of the material in the desired size range, 140 +170 mesh (88 to 105μ) was produced; previously −80 +100 mesh material has been prepared. Further, the density of the product (9.8 g/cc) was the highest thus far attained at 650°C. (auth)

43707 (CEA-R-2594) UTILISATION DE LA TRILAURYLAMINE AU RETRAITEMENT DES COMBUSTIBLES IRRADIES. (Use of Trilaurylamine During the Reprocessing of Irradiated Fuels). André Bathellier, Gérard Koehly, Jean-Jacques Perez, and André Chesne (France. Commissariat à l'Energie Atomique. Centre d'Études Nucléaires, Fontenay-aux-Roses). Aug. 1964. 60p.

The purification of aqueous solutions of plutonium can be made by extraction of the Pu(IV) nitrate complex using trilaurylamine in dodecane. The principal physical properties of this solution are considered along with its extractive properties and the influence of foreign ions on the extraction. The application of this method of extraction in a processing cycle for irradiated material is proposed: either for a final purification process or for auxiliary cycles for recovering plutonium from metal production wastes, oxalate precipitation supernatants, or any general aqueous plutonium waste solution. Also proposed are clean-up procedures for regeneration of an extractive solution which has undergone chemical or radiolytic degradation. (auth)

43708 (EUR-1911.i) ESTRAZIONE DEL TORIO DA SOLUZIONI ACQUOSE SOLFORICO-NITRICHE MEDIANTE TRILAURILAMMINA. (Extraction of Thorium From Aqueous Sulphuric–Nitric Solutions With Trialuryl–Amine). F. Mannone and C. Stoppa (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 41p.

A study has been made of the behavior of thorium in aqueous sulphuric–nitric and solutions during extraction with 20% trilaurylamine (TLA) in dodecane. The batch tests were performed by alternative variation of the following parameters: hydrogen–ion concentration, total anion concentration, and fraction of nitrate ions. The experimental results show that: the thorium distribution coefficients are lower than 10^{-3}, the TLA nitrate extracted in organic phase is more stable than TLA sulphate, and the uranium–thorium separation under these conditions can be best achieved if the starting solutions have low concentrations of hydrogen ions and total anions and a low fraction of nitrate ions. (auth)

43709 (EURAEC-972) REPROCESSING OF IRRADIATED FUELS. Quarterly Report No. 15, October 1–December 31, 1963. J. Schmets (Centre d'Étude de l'Énergie Nucléaire, Mol, Belgium). Work Performed under United States–Euratom Joint Research and Development Program. Contract 098-62-11-RDB. 29p. (R-2277)

The study of the fluorination and hydrofluorination of PuO_2–UO_2 mixtures was continued. Research on the transformation of fluorides into oxides using nitric vapors was undertaken. Optimization of the UO_2 oxidation and hydrofluorination stages is continuing on a 4-kg scale. Tests on sintered UO_2 containing 2% fission were initiated to develop reprocessing methods. Oxidation of this mixture was found to require more rigid working conditions than those required for pure UO_2. Within the scope of the research dealing with U–Pu separation, the action of ClF_3 on the UF_4–UO_2F_2 mixture was studied; the use of various fluidization flows and ClF_3 concentrations enabled curves for the reaction rate and ClF_3 consumption to be established. Conditions were found under which about 99.9% of the U was volatilized. Tests relative to the hot semi-pilot (UF_6 condenser, scrubbing gaseous effluents, filters) were continued. The molten salts technique were used in the separation of Pu and U and with their conversion into oxide starting from UF_6, UF_4 and PuF_4. The research relative to the decontamination of irradiated UO_2 by chlorination using PCl_5 and by volatilization of certain complexes formed with $POCl_3$

was continued. The stability of the $UCl_4 \cdot POCl_3$ complex adds to the difficulty of subsequent treatment. (auth)

43710 (EURAEC-1153) COMMENTS ON THE DECONTAMINATION FACTOR DURING URANIUM REPROCESSING BY VOLATILIZATION. Special Report No. 4. J. Schmets (Centre d'Étude de l'Énergie Nucléaire, Mol, Belgium). Mar. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 098-62-11-RDB. 17p. (R-2290)

The possibilities of being able to comply with the specifications relative to the decontamination level for UF_6 derived from reprocessing by halogenation, are as follows:

Specifications	Possibilities
A.E.C.	Not excluded but basic data lacking
U.K.A.E.A.	Probable
Refabrication outside enclosures	Probable
Refabrication without protection	Certain

(auth)

43711 (KLX-1752) CONCEPTUAL DESIGN OF REMOTE REFABRICATION PLANT FOR ATOMIC POWER DEVELOPMENT ASSOCIATES. V. J. Salemme and J. Koslov (Vitro Corp. of America. Vitro Engineering Div., New York). Feb. 29, 1956. 155p.

A conceptual design has been prepared of a remotely operated plant for the refabrication of plates and assembly of these plates into highly radioactive fuel elements. This design includes the necessary process description, equipment data sheets, and engineering drawings, as well as a discussion of safety and maintenance. Processing of spent fuel material is accomplished in an adjacent plant, (structurally part of the same building) where ingots are cast for prompt use in the refabrication plant. The access tunnel from the reactor, air locks, argon supply system, stack, office space, and other plant facilities and services are shared by reprocessing and refabrication plants. The total capital cost of the refabrication plant design presented is estimated at $1,542,000, over and above the cost of the pyrometallurgical reprocessing facility. The annual operating cost for the facility presented is estimated at $292,100. (auth)

43712 (NLCO-920(p.63-70)) THE RECOVERY OF URANIUM FROM MAGNESIUM FLUORIDE SLAG VIA A LOW-TEMPERATURE NITRIC ACID LEACHING PROCESS. T. P. Scheidler, R. C. Kispert, S. A. Sauerland, and R. N. Leist (National Lead Co. of Ohio, Cincinnati).

A low temperature nitric acid leaching process for recovering uranium from magnesium fluoride (MgF_2) slag was successfully employed in a plant test. Slurry batches containing 55 wt % solid material proved to be superior to batches containing 25 wt % solids, with respect to materials handling and overall uranium recovery. Fluoride corrosion of the stainless steel (type 304 ELC or 304 L) equipment was neglibible. (auth)

43713 (NP-11895) STRIPPING OF NITRIC ACID AND URANIUM FROM TLA BY SULFURIC ACID. G. Calleri, G. Rolandi, and G. Leynen (European Company for the Chemical Processing of Irradiated Fuels, Mol, Belgium). July 18, 1961. 17p. (ETR-116)

Results of preliminary tests made with the nitric acid–sulfuric acid–trilauryl amine (TLA) system to determine the stripping efficiency for transferring plutonium into an aqueous phase are discussed. Distribution coefficients were determined for U, substituting for Pu, between TLA and mixtures of nitric and sulfuric acids. (J.R.D.)

43714 (ORNL-1993(Rev.2)) CHEMICAL DEVELOPMENT OF THE 25-TBP PROCESS. J. R. Flanary, J. H. Goode, A. H. Kibbey, J. T. Roberts, R. G. Wymer (Oak Ridge National Lab., Tenn.). Oct. 1964. Contract W-7405-eng-26. 63p.

Laboratory development studies leading to a tributyl phosphate extraction process for recovering ^{235}U from irradiated, enriched, uranium–aluminum alloy reactor fuel elements are described. The fuel is dissolved in excess nitric acid, and the solution is digested to eliminate emulsion-forming substances and then extracted with tributyl phosphate, aluminum nitrate being the salting agent. The uranium is then stripped with dilute nitric acid, and, after evaporation, is reextracted in a second cycle. Nitric acid is used as the salting agent in the second cycle. The solvent diluent is pretreated to remove impurities. Procedures for recovering the solvent for process reuse and for reducing the volume of the radioactive waste, which contains aluminum nitrate, are proposed. (auth)

43715 (ORNL-3693) THERMODYNAMIC CALCULATIONS RELATING TO CHLORIDE VOLATILITY PROCESSING OF NUCLEAR FUELS. II. THE CAPACITY OF CHLORINE FOR TRANSPORTING PLUTONIUM TETRACHLORIDE VAPOR DURING REACTION OF $U_3O_8-PuO_2$ WITH CARBON TETRACHLORIDE. T. A. Gens (Oak Ridge National Lab., Tenn.). Oct. 1964. Contract W-7405-eng-26. 38p.

The capacity of chlorine gas for transporting plutonium tetrachloride vapor in the presence of UCl_5 and UCl_6 formed in the reaction of $U_3O_8-PuO_2$ with carbon tetrachloride vapor at 1 atm was estimated f om free-energy data as a function of temperature between 500 and 1050°K and the amounts of chlorine and inert gas introduced. It was determined that the presence of UCl_5 and UCl_6 has little effect on the capacity of chlorine for transporting $PuCl_4$. This capacity can be estimated closely from the capacity in the $PuCl_3-Cl_2$ system in the absence of uranium chlorides, where it increases from about 3×10^{-6} to 10^{-2} mole of $PuCl_4$ per mole of chlorine as the temperature increases from 700 to 1000°K. The capacity is sufficient to transport the plutonium produced by neutron irradiation of natural or slightly enriched uranium oxide fuels, where the maximum plutonium content expected after long-term irradiation exposure is less than 1 wt %. Thus, simultaneous volatilization and transportation of plutonium and uranium should be feasible. Equations were developed for calculating the capacity of chlorine for transporting $PuCl_4$ for all compositions of PuO_2 in uranium oxide, but calculations were made only for fuels containing up to 1.7 wt % PuO_2. Based on these calculations, a practical set of operating conditions for volatilization of uranium and plutonium from uranium oxide fuels containing up to 1 wt % PuO_2 would be reaction at 550°C with Cl_2 saturated with CCl_4 vapor at room temperature (85 vol % Cl_2–15 vol % CCl_4). (auth)

43716 (ORNL-P-313) RECOVERY OF URANIUM FROM SPENT ZIRCONIUM-BASED REACTOR FUELS IN THE OAK RIDGE VOLATILITY PILOT PLANT. W. H. Carr, R. E. Brooksbank, S. Mann, and R. P. Milford (Oak Ridge National Lab., Tenn.). July 16, 1964. Contract W-7405-eng-26. 10p. (CONF-653-3)

From American Chemical Society Symposium, Chicago, Sept. 1964.

A molten-salt fluoride-volatility process for the recovery and purification of unburned uranium in spent nuclear fuels has been developed. In this nonaqueous process, as applied to U–Zr alloy, the fuel is dissolved into molten $LiF-NaF-ZrF_4$ at 650°C by hydrogen fluoride. Fluorine is used to convert the UF_4 in the resulting salt to volatile UF_6. This partially decontaminated UF_6 is further purified in NaF and MgF_2 absorber beds and then recovered in cold traps. The process was studied in the Volatility Pilot Plant with enriched, highly burned U–Zr alloy fuel elements decayed for as short a time as six months. The uranium product recovered during the pilot plant operation met requirements for return to production channels. Decontamination from fission products was among the best ever reported; in one run, the decontamination factor from $^{95}Zr-Nb$ exceeded 5×10^{10}. Uranium losses below 0.2% and the capability for sustained operation were demonstrated. The process offers several advantages over aqueous methods for treating enriched zirconium-based fuel. These include reduced process and waste volumes, and increased nuclear safety. A disadvantage is the higher corrosion rate encountered in certain steps. A commercial plant for irradiated U–Zr alloy fuels can be designed on the basis of present knowledge. (auth)

43717 (ORNL-P-391) A FUSED-SALT FLUORIDE-VOLATILITY PROCESS FOR RECOVERING URANIUM FROM SPENT ALUMINUM-BASED FUEL ELEMENTS. M. R. Bennett, G. I. Cathers, R. P. Milford, W. W. Pitt, Jr., and J. W. Ullmann (Oak Ridge National Lab., Tenn.). [nd]. Contract [W-7405-eng-26]. 33p. (CONF-571-14)

From American Chemical Society 148th National Meeting, Chicago, Aug.-Sept. 1964.

A discussion is given of the development of a molten-salt fluoride-volatility process for Al–U alloy fuels on laboratory and semiworks scales. In this process, the fuel is dissolved in $KF-ZrF_4-AlF_3$, and the U is converted to the volatile hexafluoride and further purified by passing through NaF and MgF_2 beds. The advantages and disadvantages of the process are outlined. The studies of the process covered the dissolution rates of Al in $KF-ZrF_4$ with and without AlF_3, reaction mechanisms in the dissolution, step and partial-transfer flowsheets for the molten salt, fluorination of U in the molten salt, and corrosion of INOR-8, HyMu 80, and nickel 201. (D.L.C.)

43718 PROCESSING OF IRRADIATED FUEL. W. Kraak. Atoomenergie Haar Toepassingen, 6: 133-40(July 1964). (In Dutch)

The introduction to a series of articles on the processing of irradiated fuels is presented. The chemical principles of the reprocessing are reviewed. A survey of the activities of the nations of Western Europe is given. (J.S.R.)

43719 ION EXCHANGE METHOD FOR THE QUANTITATIVE SEPARATION OF THE ALKALINE AND ALKALINE EARTH IONS AND ITS APPLICATION TO THE DETERMINATION OF K, ^{137}Cs, Ca, ^{89}Sr, AND ^{90}Sr IN MILK. Marco M. Ferraris (Comitato Nazionale per l'Energia Nucleare, C.S.N., Casaccia, Italy). Health Phys., 10: 833-6(Nov. 1964).

An easy and inexpensive method is described for the quantitative separation of the alkaline and alkaline earth ions from milk using resin Amberlite CC120 100 to 200 mesh columns. Applications in the determination of K, ^{137}Cs, Ca, ^{89}Sr, and ^{90}Sr in milk are discussed. (C.H.)

43720 CATION EXCHANGE ON ZIRCONIUM PHOSPHATE AT ELEVATED TEMPERATURES. C. B. Amphlett and P. J. Jones (Atomic Energy Research Establishment, Harwell, Berks, Eng.). J. Inorg. Nucl. Chem., 26: 1759-61(Oct. 1964).

The uptake of potassium ions on zirconium phosphate ion exchanger was studied between 18 and 300°C. The uptake was found to decrease between 18 and 160°C, in conformity with a reversible exchange between K^+ and H^+ ions having a negative enthalpy. Between 150 and 200°C the uptake increased markedly and then became approximately constant at ~300°C. The reversibility of exchange at temperatures up to 160°C was demonstrated by the fact that the cation could very readily be removed with dilute acid, in addition, if the solution was cooled to room temperature after equilibration at 160°C the final uptake was that corresponding to room temperature conditions. This was not true when the exchanger was treated with solutions at 200 to 300°C. Then the measured uptake after cooling remained equal to that corresponding to the highest temperature attained. (M.C.G.)

43721 EXCHANGE PROPERTIES OF COMPLEX CYANIDES. II. ION EXCHANGE OF ALKALI METALS ON ZINC FERROCYANIDE. V. Kouřím, J. Rais, and J. Stejskal (Nuclear Research Inst., Řež, Czechoslovakia). J. Inorg. Nucl. Chem., 26: 1761-3(Oct. 1963).

Zinc ferrocyanide was prepared and distribution coefficients for alkali metals on it were determined. ^{137}Cs, ^{86}Rb, ^{42}K, and ^{24}Na were used as tracers. The reaction was found to be a true ion exchange ruled by the mass action law and efficient separation was achieved. (M.C.G.)

43722 EXTRACTION OF URANIUM FROM SEA WATER. R. V. Davies (Atomic Energy Research Establishment, Harwell, Berks, Eng.), J. Kennedy, R. W. McIlroy, R. Spence, and K. M. Hill. Nature, 203: 1110-15(Sept. 12, 1964).

A summary of the program to separate uranium from sea water by continuous counter-current extraction is presented. (C.E.S.)

43723 FUEL REPROCESSING. R. C. Vogel. Nucl. News, 7: No. 10, 90-2(Oct. 1964).

A summary is given of the Geneva Conference papers on the Windscale Plant, the reprocessing plant at Trombay, India, solvent-extraction work, the fluoride volatility process, and pyrometallurgical processes. (C.E.S.)

43724 SYNERGISM IN THE SOLVENT EXTRACTION OF ALKALI METALS. L. A. Bray (General Electric Co., Richland, Wash.). Nucl. Sci. Eng., 20: 362-4(Nov. 1964). (HW-SA-3094)

It was found that a mixture of di(2-ethylhexyl)phosphoric acid and 4-sec-butyl-2-(α-methylbenzyl)phenol (BAMBP) will coextract Sr, Ce, and Cs from acidic solutions. A synergistic effect occurs in the BAMBP-alkyl phosphate system, broadening the range of effective cesium extraction to pH 2 to 14 with a 30-fold increase in cesium distribution occurring at a pH of 4.5. The synergistic effect was also observed in other phenols and acid phosphates. (D.C.W.)

43725 THE REPROCESSING OF IRRADIATED FUEL IN THE UNITED KINGDOM. L. P. Shortis (Windscale Works, Sellafield, Cumb., Eng.), D. W. Clelland, T. G. Hughes, B. F. Warner, E. G. Spalding, and R. G. Tongue.

Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 1963, 1: 233-73.

The process, plant description, design philosophy, and operational experience of the reprocessing of irradiated fuel in the United Kingdom are discussed. (C.E.S.)

43726 ION FLOTATION. Felix Sebba. Elsevier Monographs. Engineering Section. New York, Elsevier Publishing Co., 1962. 159p.

The ion flotation method for separation and concentration of charged entities from aqueous solutions is reviewed. Topics covered include: surface activity, micelles, foams and froths, ions in solution, ion flotation, sublate salts, selectivity, applications, solvent sublation, organic ion flotation, analytical applications, wastes and effluents, and concentration from the sea. (M.C.G.)

43727 SEPARATION OF PLUTONIUM, URANIUM, AMERICIUM AND FISSION PRODUCTS FROM EACH OTHER. James B. Knighton and Robert K. Steunenberg (to U. S. Atomic Energy Commission). U. S. Patent 3,147,109. Sept. 1, 1964.

A process was developed for separating americium from curium. The americium–curium mixture is contacted with a molten halide containing at least 50 mole % magnesium halide and at the same time with magnesium–zinc or magnesium–cadmium alloys containing between 10 and 90 wt % magnesium. The americium is taken up by the halide, the curium by the alloy. (AEC)

43728 DISSOLUTION OF URANIUM–MOLYBDENUM REACTOR FUEL ELEMENTS. T. A. Gens (to U. S. Atomic Energy Commission). U. S. Patent 3,148,941. Sept. 15, 1964.

A process was developed for separating uranium from a uranium–molybdenum composition by contacting the U–Mo alloy with a gaseous mixture consisting essentially of hydrogen chloride and air at a temperature in the range of about 400 to 600°C to selectively volatilize at least a major portion of the molybdenum as molybdenum oxychloride. The resultant uranium oxide-containing residue is recovered. (AEC)

43729 FLUIDIZED SOLIDS PROCESS FOR RECOVERY OF URANIUM FROM ZIRCONIUM-TYPE FUEL ELEMENTS. L. P. Hatch, J. J. Reilly, and W. H. Regan, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,149,909. Sept. 22, 1964.

A process was developed for recovering uranium from zirconium-clad uranium-bearing nuclear fuel elements wherein zirconium decladding and uranium recovery are accomplished in the same fluidized bed reactor. The decladding is carried out by contacting the clad element with anhydrous hydrogen chloride and the exposed uranium is volatilized by contacting the uranium with gaseous fluorine. Both decladding and volatilization are carried out in the presence of a fluidized bed of inert granules. (AEC)

43730 ION EXCHANGE RESIN WITH SCINTILLATING PROPERTIES. Alvin H. Heimbuch (to U. S. Atomic Energy Commission). U. S. Patent 3,150,101. Sept. 22, 1964.

A scintillating ion exchange resin was developed, which consists of a bead of a polymer selected from the group consisting of polyvinyltoluene and/or polystyrene, cross-linked with divinylbenzene containing a scintillating phosphor in solid solution, and a coating of an ion-exchange resin on the surface of the bead. (AEC)

43731 REMOVAL OF HYDROCARBON DEGRADATION PRODUCTS FROM ORGANIC SOLUTIONS. J. M. Schmitt (to U. S. Atomic Energy Commission). U. S. Patent 3,150,159. Sept. 22, 1964.

Methods of purifying organic solutions containing hydrocarbon diluents are described. When the solutions are contacted with nitric acid, as in a liquid-liquid extraction process, reaction products form, which change the selectivity of the extracting solution for some metal values. These reaction products may be removed from the organic solution containing them by contacting the solution with an aqueous solution of a water-soluble amine and separating the resulting organic and aqueous phases. (AEC)

43732 PURIFICATION OF YTTRIUM METAL. Oscar Norman Carlson, Frederick A. Schmidt, and Joseph A. Haefling (to U. S. Atomic Energy Commission). U. S. Patent 3,150,964. Sept. 29, 1964.

A process was developed for removing impurities from crude yttrium by dissolving it in a small quantity of molten magnesium chloride. Yttrium chloride and magnesium metal are formed and the impurities extracted into the yttrium chloride. The yttrium–magnesium alloy formed is separated from the yttrium chloride and heated for volatilization of the magnesium. (AEC)

43733 AMERICIUM–CURIUM SEPARATION. Stephen Lawroski, James B. Knighton, and Robert K. Steunenberg (to U. S. Atomic Energy Commission). U. S. Patent 3,152,887. Oct. 13, 1964.

A process was developed for separating americium from curium. A molten salt containing magnesium halide and a magnesium–zinc alloy were added to the mixture containing the two actinides; the curium was taken up by the alloy and the americium as the halide by the salt. (AEC)

43734 POTASSIUM LANTHANUM SULFATE SEPARATION PROCESS. Michael Cefola (to U. S. Atomic Energy Commission). U. S. Patent 3,154,375. Oct. 27, 1964.

A process was developed for precipitating tetravalent plutonium ions with potassium and sulfate ions from a solution whose pH value is below 7.1. A lower alkyl alcohol containing up to 3 carbon atoms and being miscible in all proportions with water was added to the solution to improve separation. The alcohol content of the aqueous-alcohol mixture should range from 10 to 50% by weight. (AEC)

43735 EMULSION CONTROL IN LIQUID-SUSPENSION EXTRACTION. Bernice E. Paige, Kenneth L. Rohde, and Bill J. Newby (to U. S. Atomic Energy Commission). U. S. Patent 3,154,376. Oct. 27, 1964.

A method of solvent extraction of uranium and plutonium values from a solution containing siliceous suspended matter is described. Gelatin is added to the solution, which is then boiled. Then, without filtering or any other step for removing the suspended matter the solution is put into contact with an organic extractant and agitated. No persistent emulsion is produced by the agitation, and when it is completed the aqueous and organic phases coalesce readily. (AEC)

43736 PLUTONIUM SEPARATION FROM URANIUM AND LANTHANIDES BY PRECIPITATION FROM MOLTEN CHLORIDE SOLUTIONS. Glen E. Benedict and John L. Swanson (to U. S. Atomic Energy Commission). U. S. Patent 3,154,379. Oct. 27, 1964.

A process was developed for recovering pure plutonium dioxide from a mixture with uranium and rare earths by dissolving in lithium chloride–potassium chloride (or sodium chloride) systems with a mole ratio between 2 and

3 and sparging with chlorine while introducing oxygen or stannic oxide. The plutonium dioxide is thereby precipitated. (AEC)

43737 URANIUM RECOVERY FROM ORE CONCENTRATES. James B. Knighton, Robert K. Steunenberg, and Joseph P. LaPlante (to U. S. Atomic Energy Commission). U. S. Patent 3,154,408. Oct. 27, 1964.

A process was developed for recovering pure uranium metal from contaminated oxidic ore concentrates by introducing the latter into and agitating it in a molten magnesium chloride-containing flux containing from 2 to 20 mole % of CaF_2 or MgF_2 and having a magnesium cation content of at least 10% while in contact with air. A magnesium–zinc alloy is added for reduction of uranium oxide and formation of a magnesium–zinc–uranium phase separate from the contaminants-containing flux. (AEC)

ENGINEERING

General

43738 (AECL-2030) STUDIES OF DILUTION IN THE OTTAWA RIVER USING RHODAMINE B. 2. CRNL TO PEMBROKE. W. F. Merritt (Atomic Energy of Canada Ltd., Chalk River, Ont.). July 1964. 10p.

Rhodamine B, a fluorescent dye, was used to study dilution in the Ottawa river downstream of the CRNL reactor site. Dye was injected into the Process sewer and the concentration measured as it dispersed into the river and moved downstream. Addition times were varied from 20 minutes to 3 days to simulate typical radioactive releases. An initial dilution factor of 7 was observed at the river surface above the outfall. The dye dispersed into the wide deep section of the river downstream of the plant and was completely mixed throughout the river 8 km downstream. Short term discharges mixed throughout a large volume of the river, giving high dilution factors. Transit time to Pembroke (33 km) was 10 days. The tracer was detected as far downriver as Ottawa (200 km). (auth)

43739 (ANL-6905) BENDING OF CIRCULAR PLATES UNDER A UNIFORM LOAD ON A CONCENTRIC CIRCLE. J. C. Heap (Argonne National Lab., Ill.). Apr. 1964. Contract W-31-109-eng-38. 41p.

The basic equations of deflection, slope, and moments for a thin, flat, circular plate subjected to a uniform load on a concentric circle were derived for four generalized cases. From these generalized cases, six simplified cases were deduced. The four generalized cases have the uniform load acting on a concentric circle of the plate between the inner and outer edges, with the following boundary conditions: (1) outer edge supported and fixed, inner edge fixed; (2) outer edge simply supported, inner edge free; (3) outer edge simply supported, inner edge fixed; and (4) outer edge supported and fixed, inner edge free. (auth)

43740 (NAA-SR-Memo-9963) LOW LEVEL VIBRATION TESTING OF R/C 6. H. R. Kapp (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 28, 1964. Contract AT-11-1-GEN-8. 35p.

The R/C 6 structure was subjected to low level vibration tests in accordance with specification NAA-NR-7562-03 to determine the structure's dynamic characteristics. Both measured values of acceleration and resonant frequencies and calculated values of amplification factors and damping values are presented. (auth)

43741 (ORO-619) RADIOACTIVITY TRANSPORT IN WATER— THE DISPERSION OF RADIONUCLIDES IN OPEN CHANNEL FLOW (thesis). Technical Report No. 2. Calvin Clyde Patterson (Los Alamos Scientific Lab., N. Mex.); and E. F. Floyna (Texas. Univ., Austin. Environmental Health Engineering Research Lab.). June 1, 1963. Contract AT(11-1)-490. 105p.

Submitted by Calvin Clyde Patterson to Univ. of Texas.

Fluorescent organic dyes were used as tracers in studies of dispersion in the Colorado River (a wide shaft river) and Pierce Canal (a narrow slow-moving canal). Longitudinal dispersion was measured in both, and transverse dispersion was measured in the Colorado River. The measured coefficients were: $D_x = 14.4$ ft^2/sec (Colorado River), $D_x = 1.14$ ft^2/sec (Pierce Canal), and $D_y = 0.55$ ft^2/sec (Colorado River). The following empirical dispersion coefficient equation was derived: $D_x = 0.8e^{0.34U\sqrt{A}}$, where U = mean velocity and A = cross-sectional area of the channel. (D.L.C.)

43742 (RFP-425) LUBRICATION TECHNICAL MANUAL— ORGANIZED LUBRICATION, A PART OF MAINTENANCE. N. H. Miller (Dow Chemical Co. Rocky Flats Div., Golden, Colo.). [nd]. Contract AT(29-1)-1106. 32p.

The importance of lubrication in hydraulic-operated machines is pointed out. The integration of lubrication with maintenance is discussed. Laboratory analysis of used lubricants can result in detection of equipment deficiencies. Some of the activities and practical results of the Lubrication Section in the Maintenance Dept. at Rocky Flats are described. Finally, a technical manual is given on the basic lubrication products and techniques used. (D.L.C.)

43743 (SC-DC-64-1517X) TEMPERATURE AND THERMAL STRESS DISTRIBUTIONS IN CIRCULAR CYLINDERS. Technical Report ME-11. William E. Putman, Robert S. Pritchard, and Maurice W. Wildin (New Mexico. Univ., Albuquerque. Engineering Experiment Station). Aug. 1964. Sandia Corp., Albuquerque, N. Mex. Contract AT(29-1)-789. 180p.

The investigation of the thermal stresses which occur in a long cylindrical rod being cooled by emission of thermal radiation has been continued in an effort to obtain experimental verification and further analytical support for the analytical results reported previously. An alternate analytical solution has been obtained, the results of which substantiate, for small changes in surface temperature, the earlier results. The experimental program has proceeded much less rapidly than expected, due to difficulties in measuring the thermal conductivity and emittance of the model material. As a result, experimental verification of the analytical results has not yet been accomplished. (auth)

43744 (TID-7697(p.4.1.1-17)) A.E.R.E. EXPERIENCE IN DEVELOPMENT OF CAPSULE COMPONENTS. C. B. T. Braunton and D. R. Dance (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

Since most capsule irradiation experiments at AERE involve the simultaneous irradiation of several capsules, high standards of manufacture and assembly of capsule components must be strived for. A survey is presented of AERE development effort in heaters, thermocouples, ceramic/metal seals, sodium-resistant and high-temperature brazes, and miscellaneous problems. (D.L.C.)

43745 (NP-tr-1183) ON THE PRODUCTION OF HIGH MAGNETIC FIELDS FOR SHORT PERIODS. Piero Cotti. Translated by G. Atlass (U.K.A.E.A., Atomic Energy Research Establishment, Harwell, Berks, Eng.), from Z. Angew. Math. Phys., 11: 17-32(1960). 29p. (Includes original, 9p.).

The design of an apparatus for producing very high pulsed magnetic fields using condenser discharges is dis-

cussed. Efficiency, heating, and strength are investigated. The calculations are compared with experimental data on coil types producing 320,000 amp/cm (400,000 Oe) for 1 msec in a volume of 0.5 cm^3 and 80,000 amp/cm (100,000 Oe) for 100 msec in 10 cm^3. Results of magnetoresistance measurements on copper to 260,000 amp/cm (325,000 Oe) at liquid-nitrogen temperature and to 160,000 amp/cm (200,000 Oe) at liquid helium temperature are given. In a Kohler diagram these results are in agreement with work by Chambers on purer specimens in lower fields. (auth)

43746 NUCLEAR APPLICATIONS IN COKE PLANT AND BLAST FURNACE OPERATIONS. T. J. Radcliffe. Blast Furnace Steel Plant, 52: 611-20(July 1964).

An illustration of the fundamental principle of nuclear gaging and typical examples of nuclear development applications in coke plants and blast furnace operations are given. Included are coke plant alignment gaging, conveyor automation, telemetering, bulk density control, blast furnace stock level gaging, and nuclear moisture measurement. Plant radiation safety procedures are summarized. (Rev. Metal Lit., 21: No. 9, Sept. 1964)

Applications of Nuclear Explosions

Refer also to abstract 44004.

43747 (UCRL-7963) ISOTOPE PRODUCTION WITH NUCLEAR EXPLOSIVES. R. A. Heckman (California. Univ., Livermore. Lawrence Radiation Lab.). July 16, 1964. Contract W-7405-eng-48. 33p. (CONF-718-1)

From American Institute of Chemical Engineers Meeting, Las Vegas, Nev., Sept. 1964.

The production of isotopes by capture of the neutron fluxes associated with a nuclear detonation is discussed. The phenomenology of contained underground detonations in different geological media is given. The chemistry of the desired isotope may dictate the choice of nuclear explosive yield and the detonation medium. Suitable choice of the detonation medium will allow higher product recovery as well as lower overall processing and purification costs. Small quantities of undesirable impurities in the medium may scavenge the product with significant increases in processing costs. The neutron flux and energy spectrum found in a thermonuclear explosion may be exploited to produce unique isotopes. The high energies associated with thermonuclear burn may produce (n,2n) and (n,particle) reactions. The fluxes of these high energy neutrons are orders of magnitude greater than those presently available from reactors. A further type of nuclear reaction that is unique to the high flux is multiple neutron capture in time periods so short that beta decay cannot occur between captures. Cost estimates are derived for the effective costs of neutrons from nuclear explosives. A relative cost comparison of isotopes produced by this method and conventional sources is included. The applicability of this method to produce new and useful radiotracers for nuclear medical studies is discussed in some detail. (auth)

Facilities and Equipment

Refer also to abstract 45070.

43748 (ACF-1) LARGE DIAMETER METAL SEALS FOR NUCLEAR ROCKET APPLICATIONS. Paper No. V-II. S. E. Logan and C. A. Walker (ACF Industries, Inc. Albuquerque Div., N. Mex.). [Aug. 18, 1964]. Contract AT(29-1)-1352. 22p. (CONF-554-11)

From Cryogenic Engineering Conference, Philadelphia, Aug. 1964.

Large-diameter metal seals are used in the reactor pressure vessels of nuclear rocket engines. The large-diameter problem is described, and several types of seals were developed to meet this problem. These types were the X-Seal, Omega Seal, and Wave Ring Seal. Results of testing on a scale model vessel are given. (D.L.C.)

43749 (UCRL-11007) THERMAL CHARACTERISTICS OF A 150-kw ARC IMAGE SYSTEM. Ira Pratt, Mark Davis, T. H. Hazlett, and Robert Eberhart (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 1963. Contract W-7405-eng-48. 17p.

A discussion is given of the thermal and electrical characteristics of an arc image unit consisting of a pair of 60-inch parabolic mirrors mounted in a 9-foot diameter sphere, and a pressurized argon plasma source with a current that may exceed 2700 amperes at 65 volts. Curves of the radiant flux profile and density are presented. (auth)

43750 THE EUROPEAN PLANT FOR PROCESSING IRRADIATED FUEL ELEMENTS AT MOL (BELGIUM). [PART] I. T. J. Barendregt. Atoomenergie Haar Toepassingen, 6: 155-63(Aug. 1964). (In Dutch)

A description is given of the organization and development of Eurochemic. The need existing in Europe for fuel processing is indicated. The construction of the processing installation at Mol and its general plan are described. (J.S.R.)

43751 ATTEMPTS TO COMBINE ELECTROSTATIC PRECIPITATION AND INERTIAL COLLECTION IN A FILTER FOR RADIOACTIVE AEROSOL SAMPLING. J. Flattau. Central. Inst. Ochrony Pracy, 13: 109-26 (1963). (In Polish)

The development of a test filter to measure the radioactivity of aerosols, for the purpose of testing whether the sampling efficiency can be improved by combining electrostatic precipitation and inertial collection, is reported. The filter consists chiefly of a set of corona electrodes, a nozzle and a collection electrode adapted for mounting a cover glass. Filtering efficiency, depending on the type of filter and the conditions of measurement, was between 57 and 17%, whereas precipitation efficiency was from 3 to 6.6%. Filtering efficiency depended upon many other factors which were probably also electrostatic in character. It was established that radioactive decay products are deposited not only on fine particles but also on coarser particles, which is a result contrary to those obtained by Wilkening. (Occupational Safety Health Abstr., 2: No. 7, 1964)

43752 DIRECT FLOW FILTER SAMPLER. AN IMPROVED LARGE VOLUME COLLECTOR OF RADIOACTIVE STRATOSPHERIC DEBRIS. R. C. Wood. J. Appl. Meteorol., 3: 194-7(Apr. 1964).

The direct flow sampler is an improved balloon-borne device designed to collect particulate matter from very large volumes of stratospheric air at altitudes between 50,000 and 100,000 ft. Laboratory tests at low pressures involving aerosols of known size and density, together with intercomparison flights with other sampling devices, indicate that the direct flow sampler is a very efficient collector of submicron particles. Several vertical profiles of radioactivity over Minneapolis, Minn., that were obtained

with impactor collectors and with filter samplers are shown to be in generally good agreement. (TCO)

43753 LABORATORY DEVICE FOR MELTING AND PROCESSING OF REFRACTORY METALS BY AN ELECTRON BEAM IN VACUUM. V. Ya. Shlyuko. Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 3, 91-4(1964). (In Russian)

The operational and structural characteristics of a new device for melting of refractory metal alloys, refractory metal carbides, and evaporation and condensation of thin films of W, Mo, Nb, Ta, Zr, and Ti are given. The component units including vacuum-melting chamber, electron gun, electromagnetic focusing system, and vacuum system are described. (Rev. Metal Lit., 21: No. 9, Sept. 1964)

43754 SPHERICAL CONTAINMENT VESSEL (Engineering Materials). (Los Alamos Scientific Lab., N. Mex.). (CAPE-1129)

Drawings (16) are presented for a spherical concrete vessel with an outer steel shell which was designed to serve as a container for explosives. The vessel is essentially a 16 ft OD steel sphere with a wall thickness of 1 in. which is surrounded by a 20 ft ID steel sphere ½ in. thick with the intermediate volume filled with concrete. In the original design, the outer steel was to be made of pentagonal segments (spherical diode cahedren segments) with flanges and gussets welded into the outer edges so that they could be assembled into a sphere by bolting flanges of adjacent segments together. This was later changed to spherical squares. Three different schemes for constructing the outer steel skin are given. One-inch spacers are inserted between the flanges. These spacers are removed after the concrete sets. A thin (¼ in. to ½ in.) silicone rubber layer between the concrete and inner steel acts as a shock cushion. A 7 ft door and several ports are provided for access to the vessel. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

43755 INCREMENTAL ELECTRICAL METHOD AND APPARATUS FOR ENERGIZING HIGH CURRENT SUPERCONDUCTING ELECTROMAGNETS. Henry L. Laquer (to U. S. Atomic Energy Commission). U. S. Patent 3,150,291. Sept. 22, 1964.

Circuitry for the incremental accumulation of magnetism in a superconductor is described. It consists of two superconductive loops having a common leg. Magnetic flux is built up in one of the loops and is transferred to the second loop by appropriate opening and closing of switches in the first loop and in the common leg. (AEC)

Heat Transfer and Fluid Flow

Refer also to abstract 44316.

43756 (AE-156) HYDRODYNAMIC INSTABILITY AND DYNAMIC BURNOUT IN NATURAL CIRCULATION TWO-PHASE FLOW. AN EXPERIMENTAL AND THEORETICAL STUDY. K. M. Becker, S. Jahnberg, I. Haga, P. T. Hansson, and R. P. Mathisen (Aktiebolaget Atomenergi, Stockholm). Sept. 1964. 41p.

A theoretical model for predicting the threshold of instability for two-phase flow in a natural circulation loop is presented. The model calculates the flow transient caused by a step disturbance of the heat input, and is based upon the conservation laws of mass, momentum, and energy in one-dimensional form. Empirical correlations are used in the model for estimating the void fractions and the two-phase flow pressure drops. The equations are solved numerically in a finite-difference approximation coded for a digital computer. An experimental study of the hydrodynamic instability and dynamic burnout in two-phase flow was performed in a natural circulation loop in the pressure range from 10 to 70 atg. The test sections were round ducts of 20, 30, and 36 mm inner diameter and 4890 mm heated length. The experimental results showed that within the ranges tested, the stability of the flow increases with increasing pressure and increasing throttling before the test section, but decreases with increasing inlet subcooling and increasing throttling after the test section. Comparing the natural circulation burnout steam qualities with corresponding forced circulation data showed that the former data were low by a factor up to 2.5. However, by applying inlet throttling of the flow the burnout values approached and finally coincided with the forced circulation data. The experimental results as well as data available from other sources were compared with the stability thresholds obtained with the theoretical model. The comparisons include circular, annular, and rod cluster geometries, and the agreement between the experimental and theoretical stability limits is good. The application of the experimental and theoretical results on the assessment of boiling heavy water reactor design is discussed. (auth)

43757 (IAEA-R206-1) PROGRESS REPORT ON FORCED CONVECTION HEAT TRANSFER AND BURNOUT IN BOILING HEAT TRANSFER. N. G. Koumoutsos (Greece. Atomic Energy Commission. "Democritus" Nuclear Research Center, Athens). June 1964. Contract 206/RB. 39p.

Theoretical aspects of the growth rate of air and vapor bubbles were studied. Preliminary experimental measurements using hydraulic models are discussed along with growth stabilization of isolated vapor bubbles created on a hot plate. (auth)

43758 (JAERI-1055) APPLICATION OF ELECTROMAGNETIC FORCE IN MIXED-PHASE FLUID. BEHAVIOR OF PARTICLES, BUBBLES OR OTHER DISPERSED PHASES IN FLUID ON WHICH ELECTROMAGNETIC FORCE IS EXERTED. Masao Hori (Japan Atomic Energy Research Inst., Tokyo). 1964. 11p.

The behavior of the dispersed phase, such as particles or bubbles, in a fluid was investigated for the case of electromagnetic force exerted on the mixed-phase fluid. The equations for predicting the condition of falling or rising of the particle and the velocity of the particle are obtained. The equations for the motion of particles in the "pinch effect" are obtained. A simple experiment is made of a solid particle in an electroconductive liquid on which electromagnetic force is exerted. (auth)

43759 (TID-7697(p.4.9.1-3)) LABORATORY EXPERIMENTS ON SODIUM HEAT TRANSFER. E. Garrett and I. H. Mac William (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

Studies are being conducted on heat transfer under conditions of boiling onset in sodium and to verify that operating conditions in-pile will not produce burnout. The studies will investigate heat transfer to a sodium pool surrounding a central rod heater and through narrow sodium-filled annuli. Descriptions are given of Mk I, II, and III assemblies which will be used in the studies. (D.L.C.)

43760 (TID-21101) BURNOUT FOR WATER AT 1000 PSIA IN SWIRL FLOW THROUGH A LONG VERTI-

CAL TUBE WITH AN INTERNAL TWISTED TAPE. Topical Report No. 2. Bruce Matzner (Columbia Univ., New York. Engineering Research Labs.). Aug. 14, 1964. Contract AT(30-3)-187. 22p.

The effect on burnout performance of adding an internal twisted tape to a long tubular heater was experimentally determined. The test section had an ID of 0.400 in. and a heated length of 16 ft. It had a snug fitting tape of 0.015 in. thickness which received one 360° twist per foot of length. Its burnout performance was compared to uniform and cosine heat flux test sections of the same basic dimensions. On the basis of burnout heat flux vs exit quality at a constant mass velocity, the Swirl Flow Test Section performed better than the Uniform Test Section and better than the Cosine Test Station except at a mass velocity of 1×10^6 lb/hr-ft^2 where little difference was observed. On the basis of steam power output vs pumping power at a constant inlet temperature, the Swirl Flow Test is superior to the Uniform Test Section but shows little advantage over the Cosine Test Section. At high mass velocity (3×10^6 lb/hr-ft^2) and low inlet subcooling, the burnout performance of the Swirl Flow Test was limited by severe flow oscillations. (auth)

43761 (UCRL-13062) LOCAL HEAT TRANSFER COEFFICIENTS AND PRESSURE DROP IN FORCED CONVECTION BOILING. V. E. Schrock and L. M. Grossman (California. Univ., Berkeley. Inst. of Engineering Research). Sept. 30, 1957. For Univ. of California Radiation Lab., Livermore. Contract [W-7405-eng-48]. 94p.

Experimental forced convection boiling equipment has been designed and constructed which accommodates small diameter tubes and provides local heat transfer and pressure drop data over a wide range of flow rates (up to 1500 lb/sec ft^2) and with heat fluxes up to 2×10^6 Btu/hr ft^2. The equipment was specifically designed for operation with water in the pressure range from atmospheric to 500 psia and with net vaporization approaching 100% of the flow. It is also suitable for studying surface boiling of subcooled liquids and obtaining "burnout" information. Data have been obtained for distilled water boiling in a $\frac{1}{8}$-in. ID stainless steel tube 20 inches long, with mass fluxes of 255 to 605 lb/sec ft^2, heat fluxes 6×10^4 to 6×10^5 Btu/hr ft^2, pressure ranging from 50 to 200 psia, and qualities from 0 to 50%. Local heat transfer coefficients were obtained ranging from 6000 to 43,000 Btu/hr ft^2°F. These data have been correlated in two regimes. For very low vapor fractions the data expressed by the ratio of local heat transfer coefficients with boiling to that for liquid flow alone (no boiling) are correlated by the heat flux alone. In this regime the effect of nucleate boiling predominates. At higher qualities the data, expressed in the same way, are correlated by the Martinelli parameter, X_{tt}, for turbulent two-phase flow. Here the volumetric fraction of the liquid is so low that nucleation is suppressed and the high values of heat transfer coefficient are attributed to the forced convection due to high vapor velocities and mass transfer from the annular liquid layer to the vapor core. Pressure gradient data were also correlated by the parameter, X_{tt}, which implies a similarity in the mechanisms of heat transfer and momentum transfer. Total pressure drop predictions made by the Martinelli-Nelson procedure gave only fair results. However, a step-wise solution of the one-dimensional momentum, continuity, and energy equations assuming a homogeneous flow with a "mixture" viscosity, and the Blasius form for the friction factor predicted the pressure distribution very accurately for a typical run (exit quality 50%, pressure drop from 148 psia at entrance to 72 psia at exit). (auth)

43762 SOME PROBLEMS OF HEAT CONDUCTION IN REACTOR FUEL ELEMENTS. Josef Schmid. Jaderna Energie, 10: 348-54(Sept. 1964). (In Czech)

The problem of heat conduction in reactor fuel elements is discussed for cases when the thermal conductivity of the fuel element material λ as well as both the heat transfer coefficient on the element boundary α and the contact resistance on the interface between different element materials ρ are dependent on the temperature. The partial differential equation of heat conduction was rewritten using the expression $\lambda(t) = \lambda_0 + \lambda_1(t)$ into a form suitable for solution by the small parameter method. The non-linear boundary conditions (the third type condition on the boundary and the condition on the interface) were also transformed, and the boundary problem was solved by an iteration process. The boundary conditions varying along the element perimeter were expanded into Fourier series and the problem was treated by matrix calculation. The boundary problem for small eccentricity of annular layers was solved in a similar way. The described method was applied to some problems connected with the reactor hot channel factors calculations. (auth)

43763 UNSTABLE PLANE PARALLEL FLOW OF PARTIALLY IONIZED GAS IN A STRONG MAGNETIC FIELD. E. G. Sakhnovskii. Prikl. Mat. i Mekhan., 28: 670-7(July-Aug. 1964). (In Russian)

A system of equations were used for determining unstable plane-parallel flow of incompressible partially ionized gas with a small Reynold's number. The calculations considered the Hall effect, the sliding of ions in relation to neutrals, and the anisotropy of viscosity. The thermal diffusion terms in ohm's law and transfer coefficients as functions of temperature were not taken into consideration. A precise solution for an arbitrary pressure drop as a function of time and for pulsing and constant pressure drops was found by means of Laplace transformation. (R.V.J.)

43764 OSCILLATIONS OF A CONVECTIVE UNSTABLE CONDUCTING FLUID IN A MAGNETIC FIELD. M. I. Shliomis. Prikl. Mat. i Mekhan., 28: 678-83(July-Aug. 1964). (In Russian)

A general study of magnetic field effects on conducting fluid convective unstability indicated that all equilibrium perturbations are developed monotonously, at least in weak fields. However, in some simple cases oscillation instability was observed. An attempt was made to find general conditions for the appearance of oscillating instabilities. (R.V.J.)

43765 SOME CONSIDERATIONS ON THE USE OF THE ONCE-THROUGH PRINCIPLE FOR STEAM GENERATION IN NUCLEAR POWER PLANTS. J. Kaegi. Sulzer Tech. Rev. (Switz.), 46: 3-13(1964).

The characteristics of once-through steam generators for use with gas- or liquid-metal-cooled nuclear power plants are investigated. A working design for such a generator based on the pressure tube concept is described. The manufacture, maintenance, safety, and control of this type of steam generator are described. (T.F.H.)

43766 TEMPERATURE DISTRIBUTIONS WITHIN A THERMOELECTRIC MODULE. D. C. Siegla (General Motors Corp., Dayton, Ohio) and J. B. Chaddock. New York, American Society of Mechanical Engineers, 1964, Paper No. 64-HT-17, 13p. $1.00. (CONF-644-14)

From 7th National Heat Transfer Conference, Cleveland, Aug. 1964.

When the insulation surrounding the thermoelements in a thermoelectric module is considered nonperfect, the solution for the temperature distribution will be three-dimensional. In spite of the difficult boundary conditions the analytical solution can be made, to a very close approximation, with the assumption of constant material properties. The resultant analytical temperature distributions are compared with a numerical solution, obtained on a high-speed digital computer, and with experimental temperatures measured in a large-scale, simulated module element. The solutions show that, with low-conductivity insulation, the temperature distribution in the thermoelement is satisfactorily given by the simple one-dimensional relations. The radial temperature variation in the insulation is, however, quite marked. (auth)

43767 HEAT EXCHANGER OR BOILER ESPECIALLY FOR MAKING USE OF THE HEAT DEVELOPED IN NUCLEAR REACTORS. (to Trepaud). First Add. No. 76,904 to French Patent 1,226,456. Nov. 6, 1961. Filed Jan. 6, 1960.

A heat exchanger or boiler was designed with an annular cylindrical casing, a plurality of parallel heat-exchange tubes within the casing, and annular header chambers communicating with the tubes and disposed at the two ends of the cylindric casing. A highly pressurized medium flows through the tubes and the header chambers, while a second medium circulates in the annular casing in the interstices between the heat-exchange tubes. The span of surface subjected to the high pressure has a maximum radial width equal to the annular tube bundle so that the wall of the header chambers may be relatively weak. Each header chamber may be formed by two annular plates resting together at two concentric annular regions, the distance between them being nearly equal to the radial width of the annular tube bundle. (IIB)

43768 HEAT EXCHANGER. (to Nuclear Power Plant Ltd. and F. Carr and B. G. Ediss). French Patent 1,248,874. Nov. 14, 1960. Priority date Feb. 23, 1959, Great Britain.

A heat exchanger adapted for use in connection with a gas-cooled nuclear reactor consists of a plurality of heat-exchange units each formed by spirally wound tubes, serving for the circulation of the working medium. The units are disposed in planes perpendicular to the main flow direction of the gaseous reactor coolant circulating through the cylindrical heat-exchanger casing. The flow direction is parallel to the casing axis. These units are divided in several groups spaced from each other in the direction of the casing axis and each group consists of one or several of the units connected in series, while the groups themselves are interconnected within the casing space. The units are disposed within one annular space formed between the wall of the casing and an inner coaxially disposed cylinder onto which the units are fixed. The inner cylinder is connected at one end to the heat-exchanger casing, while the other end may expand freely. (IIB)

43769 HEAT EXCHANGER. (to United Kingdom Atomic Energy Authority). French Patent 1,285,781. Jan. 15, 1962. Priority date Apr. 7, 1960, Great Britain.

A heat exchanger, provided for heat transfer between a primary medium, constituted by a liquid metal such as sodium or a sodium-potassium alloy, and a secondary medium constituted by water, consists of a container in which the primary medium has a free level and heat exchange tube bundles dipping in the primary medium and serving for the passage of the secondary medium. In order to increase the security, the probability of a contact of the liquid metal and water was diminished by placing the headers outside the container so that the entrance points of the tubes into the container are disposed at a level higher than the primary medium level. The tubes are divided into two groups, the first for preheating and the second for heating the secondary medium. The tubes of each group are placed in parallel planes perpendicularly to the planes of the other group. (IIB)

43770 HEAT EXCHANGER AND NUCLEAR REACTOR IN WHICH IT IS USED. (to Commissariat a l'Energie Atomique). French Patent 1,327,942. Apr. 16, 1963. Filed Apr. 13, 1962.

Heat-exchange elements were adapted to be introduced into a reactor pressure vessel via a relatively small opening in the vessel wall before they are assembled to form the inner circuit of a heat exchanger. Each of these elements consists of two header plates connected by a bundle of heat-exchange tubes. These elements are assembled in files, each containing several elements disposed in alignment. The header plates of adjacent elements of the same file are interconnected in a fluid-tight way so that the secondary medium flowing through the tubes passes successively all the elements of the same file. Preferably a biological shield provided with passages for the reactor coolant is disposed within the cylindrical reactor vessel space in order to form an upper compartment for the reactor core and a lower compartment for the heat exchanger where the reactor coolant constitutes the primary medium. (IIB)

Materials Testing

43771 (EURAEC-882) NON-DESTRUCTIVE WELDING RESEARCH. Quarterly Report No. 9, July 1, 1963–September 30, 1963. (Roentgen Technische Dienst N. V., Rotterdam). June 30, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 045-61-5 RDH. 35p.

Several discrepancies between the ultrasonic findings and the expected internal conditions with regard to the defects purposely made were found. Reason for false interpretation with respect to the ultrasonic investigation of thick steel welds is due to the welding bead. Tests are made on material 50 to 200 mm thick. Ultrasonic inspection techniques are described. (N.W.R.)

43772 (KAPL-M-6192) ONE-SIDED NORMAL TOLERANCE FACTORS. New Tables and Extended Use of Tables. G. L. Burrows (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 14, 1964. Contract W-31-109-eng-52. 41p.

Statistical tolerance limits are a practical way of measuring process capability or the degree to which a manufactured product conforms to drawing specifications. Tables of factors are readily available to compute two-sided tolerance limits based on unequal sample sizes for estimating mean and variance. The report provides tables of factors for computing one-sided tolerance limits based on unequal sample sizes for estimating mean and variance. The report also illustrates how either table can be used (1) to calculate exact tolerance limits where zero mean, normal measurement error is added to normal process variability and the ratio of variances is known and (2) to optimally allocate between primary

(production items) and second stage (repeat measurements) sampling units whether or not differential costs are involved. (auth)

43773 (ORNL-3670(p.122-8)) NONDESTRUCTIVE TEST DEVELOPMENT. R. W. McClung (Oak Ridge National Lab., Tenn.).

New techniques and equipment are being developed for the nondestructive evaluation of materials and components. The major emphasis has been on eddy-current, ultrasonic, and penetrating-radiation methods. Analytical methods have been developed and implemented with computer programming to calculate impedance of eddy-current coils to facilitate their design and application. Improved circuitry has been designed and fabricated to enhance the usefulness of the phase-sensitive eddy-current instrument. Detailed instructions have been prepared on the design and construction of coolant-channel spacing probes. Techniques were studied for the detection of nonbond in clad structures, and a number of new experimental devices were designed and built. Preliminary work shows promise for the ultrasonic evaluation of roll-swaged joints common to several fuel elements. New and improved instrumentation has been designed and built for the processing of ultrasonic data signals. Minute specimens were microradiographed after in-pile testing. In continued studies on techniques and standards for the determination of fuel inhomogeneities in fuel plates and rods, design criteria were provided for production scanners for the HFIR fuel plates. X-ray imaging television systems are being examined for use in hot cells. The method also shows promise for precision measurement of component expansion during thermal testing. In the development on problem materials including molybdenum, tungsten, tantalum, and graphite, attempts are being made to use ultrasonics to measure the strength of graphite. A principal part of the development of remote inspection techniques has been the work on radiography in the presence of a radiation background. Use of photographic reduction on the fogged film greatly increases the tolerance to background. (auth)

43774 (TID-7697(p.2.22.1-11)) RECENT ADVANCES IN NONDESTRUCTIVE EXAMINATION OF IRRADIATED FUEL CAPSULES. W. N. Beck (Argonne National Lab., Ill.).

Nondestructive examinations of irradiated, encapsulated specimens are needed in order to decide whether the capsules should be opened or returned to the reactor for further irradiation. A pinhole gamma camera and a neutron radiographic facility were built to accommodate an 11-foot irradiation capsule assembly near a reactor, and a comparison is made of the results obtained with pinhole autoradiography and neutron radiography. Only neutron radiography is presently being used at Argonne. (D.L.C.)

43775 GAMMA-RAY ONE-APERTURE "RADIATION ATTENUATION MUFF." T. A. Clarke. Brit. J. Non-Destructive Testing, 6: No. 1, 3-9(Mar. 1964).

The design of a Pb muff attached to the flexible trunking of the gamma ray source and adjustable to allow positioning for radiographic inspection of weldments in piping, turbines, and boilers is described. Comparison was made of attenuation measurements made with and without muffs to illustrate the shielding effect. (Rev. Metal Lit., 21: No. 8, Aug. 1964)

43776 NEUTRON RADIOGRAPHIC INSPECTION OF HEAVY METALS AND HYDROGENOUS MATERIALS. Harold Berger and I. R. Kraska. Mater. Evaluation, 22: 305-10(July 1964).

The inspection of heavy and intermediate metals by means of thermal neutron radiography was investigated. Exposure curves, contrast sensitivity, and image quality were determined for U, Bi, Pb, W, and steel. Results for the heavy metals indicate that the image is not influenced by other types of radiation in the neutron beam. This is somewhat less true for intermediate metals such as W and steel, although some exposure time advantages can usually be gained. (Rev. Metal Lit., 21: No. 8, Aug. 1964)

43777 THE NUCLEAR RADIATION PROBLEM. PART 2. STATE-OF-THE-ART OF SIMULATION AND APPLICATION. Sydney D. Black and Benjamin Bloch. Tech. News Bull. (Gen. Precision Aerospace), 7: 25-30(1964).

Facilities for radiation effects testing are discussed, together with measurement difficulties. The status of studies of radiation effects on electronic equipment is summarized, and measures presently being used to alleviate detrimental effects are indicated. (D.C.W.)

43778 IMPROVEMENTS RELATING TO DEVICES FOR MEASURING THE ELONGATION OF A MATERIAL UNDER TENSION, ESPECIALLY FOR CREEP TESTS UNDER IRRADIATION. (to Commissariat a l'Energie Atomique). French Patent 1,329,078. Apr. 29, 1963. Filed Apr. 27, 1962.

The device designed consists of a cavity in a nuclear reactor enclosing a support for the material samples to be tested. These samples receive a tension by means of a rod adapted to be axially displaced with the aid of a screw-nut system by an axle passing through a longitudinal channel in a plug closing the cavity. A defined torque is applied from outside the reactor via a fluid-tight coupling disposed at the outer end of the plug. The support consists of a cylindrical casing for the samples and a heating device for controlling the sample temperature. The support may further be enclosed by an annular chamber through which cooling fluid circulates. (IIB)

Vacuum Engineering

Refer also to abstract 44071.

43779 (ORNL-3670(p.262-5)) THERMONUCLEAR PROJECT. R. E. Clausing (Oak Ridge National Lab., Tenn.).

It was found that electron bombardment of metallic surfaces releases sorbed gases and appears to be a way of obtaining very clean surfaces without heating or causing radiation damage. (auth)

GEOLOGY AND MINERALOGY

General

Refer also to abstract 43396.

43780 (AFCRL-64-177) WATER WELLS IN EARTHQUAKE AND EXPLOSION DETECTION. Final Report. William Carragan, Frank Michalko, and Samuel Katz (Rensselaer Polytechnic Inst., Troy, N. Y.). June 26, 1964. Contract AF19(604)-8376. 94p.

Earthquakes and microseisms were detected for two years through observations of water-level fluctuations in open wells and pressure fluctuations in a capped well. The transducer system composed of aquifier and detector can be adjusted to provide sensitivity comparable with long-period inertial seismographs, and bandpass extended significantly in both directions. The wells recorded all of the phases normally detected by long-period inertial seismographs; they appear to be equally sensitive to Love and Rayleigh waves. Criteria were established for predicting the suitability of wells for seismic detection, using relatively simple float-recorder equipment. (auth)

43781 (CU-2663-12) OCEANOGRAPHIC WORKSHOP, 1964. Technical Report CU-12-64. Arnold L. Gordon, ed. (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). Sept. 1964. Contract AT(30-1)-2663. 59p.

An Oceanographic Workshop was held at Lamont Geological Observatory, June 8 through 12, 1964, to acquaint those with an introductory knowledge of oceanography with current methods, instruments, and skills in oceanography. Separate abstracts were prepared on six lectures presented. (C.H.)

For abstracts of individual papers see: 43782, 43783, 43784, 43785, 43786, and 43787.

43782 (CU-2663-12(p.1-2)) GENERAL INTRODUCTION TO INSTRUMENTATION. Robert D. Gerard (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory).

The need for new electrical and electronic instruments for use in oceanographic studies is discussed. It is pointed out that the basic tools used today for the study of ocean waters beneath the mixed layer are not substantially different from those used 50 yr ago. (C.H.)

43783 (CU-2663-12(p.3-19)) OCEANOGRAPHIC INSTRUMENTS FOR HYDROGRAPHIC WORK AT SEA. Robert K. Sexton (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory).

Selected instruments used to determine ocean currents and techniques involved in their use at sea are discussed. The instruments include water sampling devices, the reversing thermometer, instruments for in situ measurements of salinity, temperature, and depth, and equipment used for measuring ocean currents. The accuracies of the devices are discussed. (53 references) (C.H.)

43784 (CU-2663-12(p.20-37)) PROCESSING OCEANOGRAPHIC DATA, CORE METHOD AND GEOSTROPHIC METHOD. Arnold L. Gordon (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory).

Geostrophic and core methods for processing oceanographic data are described. It is pointed out that before a geostrophic study can be performed, the general circulation must be known in a qualitative way based on calculations of flow, its direction and magnitude, from the internal field of mass. Previous to both the core and geostrophic methods the data must be inspected and suspicious data removed. (66 references.) (C.H.)

43785 (CU-2663-12(p.38-42)) OCEAN WAVE MEASUREMENTS. Kenneth Hunkins (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory).

Parameters that describe ocean waves are outlined and instruments and methods used in wave measurements are described. It is pointed out that wave motions constantly disturb the surface and the density gradients of the oceans and the waves produce, primarily, a transfer of energy but not of matter. The ocean's wave motion is complex in space and time, involving wave lengths ranging from millimeters to thousands of kilometers and periods ranging from a fraction of a second to many days. Physical parameters used in the hydrodynamic classification of waves are discussed. (C.H.)

43786 (CU-2663-12(p.43-51)) TURBULENCE, TIDES AND DYNAMICAL OCEANOGRAPHY. Takashi Ichiye (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory).

Basic principles of dynamic oceanography are reviewed. Hydrodynamic equations applicable in oceanography and hydraulic, rotating, and mathematical models of oceanic circulation are presented. Factors that influence turbulence and tides are discussed. 30 references. (C.H.)

43787 (CU-2663-12(p.52-4)) TOPICS IN CHEMICAL OCEANOGRAPHY. Willard Moore (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory).

Salinity is defined as the total amount of solid material in grams in one kilogram of sea water after all carbonate has been converted to oxides, all bromine and iodine replaced by chlorine, and all organic material oxidized. Saturometry is defined as the measurement of the degree of saturation of $CaCo_3$ in sea water. Instruments and methods used to determine salinity and saturation in ocean waters are described. (C.H.)

43788 (INS-R-29) TRITIUM DETERMINATIONS ON BORE WATERS IN THE LIGHT OF CHLORIDE-ENTHALPY RELATIONS. S. H. Wilson (New Zealand. Inst. of Nuclear Sciences, Lower Hutt). [1963]. 19p.

The tritium contents (ranging from 0.04 to 0.44 T.U.) of the geothermal bores at Wairakei were interpreted and the calculated ages and dilutions compared with the dilutions calculated from the chloride-enthalpy curves. It is concluded that the tritium contents cannot be explained by either dilution or age, and that origin from radioactivity is the only alternative explanation. It is pointed out that in tritium determinations on samples, chloride and enthalpy should also be determined, and that evidence for additional steam in the discharge can be obtained from the higher ammonium content of the samples. (D.L.C.)

43789 (PNE-234F) STABILITY OF CRATER SLOPES. W. E. Strohm, J. S. Ferguson, Jr., and E. L. Krinitzsky (Waterways Experiment Station, Vicksburg, Miss.). Mar. 1964. Project SEDAN. 128p.

Preshot and postshot field investigations of the Sedan crater were made to obtain information on the change

in engineering properties of the subsurface soil adjacent to the crater, and to determine the engineering properties of the important physiographic features of the crater such as ejecta and fallback materials. Field investigations included geological studies of the area, undisturbed and general sample borings, and geophysical logs. Subsurface soils consisted of desert alluvium, a relatively dense mixture of silt, sand, and gravel. The foundation soils to a depth of 110 feet contained more silt and less gravel sizes, and were at somewhat lower densities than the underlying soils. Undisturbed samples were obtained from two preshot and two postshot borings to a maximum depth of 655 feet along a line bearing N45°W from surface ground zero. Results of the geophysical logs in these borings indicated an increase in postshot density for the in situ soils, with the increase becoming less with increasing distance from the crater rim. Results of laboratory density tests on undisturbed samples indicated little or no increase in postshot density. It is believed that saturation of the boring walls by drilling mud affected the results of the geophysical logs and therefore the density determinations on undisturbed samples are considered to be more dependable. The postshot borings were located close to the rim of the crater at ground surface, but with increasing depth the horizontal distance between the boring and the crater wall tended to increase so that relatively little information was obtained on changes in engineering properties close to the crater wall. Results of laboratory shear tests on undisturbed samples of in situ soils indicated an average angle of internal friction of about 43 degrees for both the preshot and postshot conditions. The surface of the ejecta, investigated by borings and field mapping, varied from 35 to 95 feet above the preshot ground surface around the crater rim. The upward displacement of the preshot ground surface around the crater rim varied from 2 to 17 feet. Extensive field mapping and examination of trenches indicated that the ejecta consisted largely of foldback materials. The ejecta, excluding aerosol transport, retained its original structure and stratification, and densities measured in the field did not differ significantly from in situ soil densities. The fallback materials deposited in the crater were loose at the surface and had a slope approximately equivalent to the angle of repose of about 35 degrees. The crater slopes above the fallback materials had relatively steep slopes averaging about 38 degrees; the factor of safety with respect to sliding is estimated to be about 1.2. These slopes are subject to degradation due to weathering. The behavior, including both immediate and long-term stability, of the slopes forming the Sedan crater is a function of the particular character of the subsurface soils and environmental factors in the area. Consequently, the results obtained at Sedan may not be applicable to other areas. (auth)

43790 (TID-21137) ANNUAL PROGRESS REPORT [ON GEOCHEMISTRY], DECEMBER 1, 1963–NOVEMBER 30, 1964. Geochemistry Technical Report 10. Karl K. Turekian (Yale Univ., New Haven). Aug. 31, 1964. Contract AT(30-1)-2912. 30p.

Work during the past year was devoted to developing techniques for the analysis of single small aliquots (~100 ml) of sea water for 18 trace elements by irradiation in a remote nuclear reactor and subsequent chemical processing. Such procedures were developed successfully for Rb, Cs, Ag, Au, Zr, Hf, Ta, Zn, Co, Hg, Se, Sb, Cr, Ni, Fe, Sc, and Ba using Sr as a natural internal standard. Application to oceanographic problems was made successfully for Rb, Cs, Ba, Au, Se, Sb, Ag, Co, and Ni; these were pursued subsequently in further studies. The probable role of organisms in vertical transport through the oceanic column has been demonstrated, although transport to the bottom sediments does not seem to be great. The probable importance of indigenous sources of trace metal supply in the South Pacific and the role of transport through the Antarctic Ocean to the Atlantic Ocean is indicated by the results. The role of trace element removal in near-shore environments was shown to be not insignificant perhaps to the point of acting as a sink for metals from the ocean as well as from streams. Further studies on the stream-ocean interface were started along the Connecticut coast and in Long Island Sound generally. By such studies it is hoped a quantitative balance sheet may be forthcoming. (auth)

43791 SYNTHESIS OF THORIANITE CRYSTALS FROM BISMUTH OXIDE–LEAD FLUORIDE MELTS. A. B. Chase and Judith A. Osmer (Aerospace Corp., El Segundo, Calif.). Am. Mineralogist, 49: 1469-71(Sept.-Oct. 1964).

A method for the growth of large thorianite crystals is described. It was found that ThO_2 crystals can be readily synthesized from the $PbO-PbF_2$, $Bi_2O_3-PbF_2$, and PbF_2 flux systems. The melts from which the largest ThO_2 crystals were grown contained 7 mole % ThO_2, 15 mole % Bi_2O_3, and 78 mole % PbF_2. Melts containing 10 mole % ThO_2 and 90% PbF_2 also produced large crystals. The materials employed were 99.99% pure ThO_2, reagent grade Bi_2O_3, and a purified grade of PbF_2. The powders were mechanically mixed (generally in 100 gram lots) and fused in tightly covered 50 ml Pt crucibles. Crystals grown by this method are easily doped with the rare earth sesquioxides and UO_2. (P.C.H.)

43792 POTASSIUM–ARGON AGE DETERMINATIONS OF CENOZOIC VOLCANIC ROCKS FROM BRITISH COLUMBIA. W. H. Mathews (Univ. of British Columbia, Vancouver, Can.). Bull. Geol. Soc. Am., 75: 465-8(May 1964).

Potassium–argon age determinations of 13 Cenozoic volcanic rocks from southern and central British Columbia indicate one to be 62 million years old (Paleocene), nine to be 45–53 million years old (Eocene), and three to be 10–13 million years old (early Pliocene or late Miocene). The concentration of Eocene dates suggests a distinct volcanic episode roughly contemporaneous with tectonic activity in the Rocky Mountains to the east. The lack of dates from 45 to 13 million years and the development of a mature erosion surface by the more recent date suggest a prolonged stage of tectonic quiescence in southern and central British Columbia in mid-Cenozoic time. (auth)

43793 A REVIEW OF AGE DETERMINATIONS FROM NORTHERN RHODESIA. N. J. Snelling (University Museum, Oxford), E. I. Hamilton, A. R. Drysdall, and C. J. Stillman. Econ. Geol., 59: 961-81(Sept.-Oct. 1964).

The significance of apparent age determinations of Northern Rhodesian rocks and minerals is considered; 31 new determinations are reported. In pre-Katanga rocks the determinations suggest igneous activity at circa 2700, 1600, and 1000 m.y. The minimum age of the Katanga system and the succeeding Lufilian orogeny is 620 m.y., as indicated by post-tectonic uranium deposits in Katanga. In Northern Rhodesia the main Lufilian diastrophism was followed by the development of the Copperbelt domes,

including the Kafue anticline. It is suggested that the Nchanga red granite, the age of which has been determined as 570 m.y., was rejuvenated during this later phase. Field and isotopic evidence indicates that this body may be a mantled gneiss dome. A second episode of uranium mineralization dated at 520 m.y. occurred, at virtually the same time as the emplacement of at least part of the Hook batholith, at 500 m.y. Later still, a mild but pervasive thermal metamorphism dated at circa 490 m.y. affected Katanga rocks over wide areas, including the Copperbelt. (auth)

43794 SEDIMENTATION RATES AND MINERALOGY IN THE SOUTH ATLANTIC. Edward D. Goldberg and John J. Griffin (Univ. of California, La Jolla). J. Geophys. Res., 69: 4293-4309(Oct. 15, 1964).

Rates of sedimentation of pelagic sediments in the South Atlantic have been determined using the ionium/thorium methodology. Values of the order of several millimeters per thousand years for sediments were found in the deposits in the valleys of the mid-Atlantic ridge. The equatorial deposits showed higher rates of accumulation than the corresponding deposits at higher latitudes, probably reflecting the added influx of materials to the sea floor from tropical rivers through the equatorial current systems. The deposits in the ridge valleys showed marked changes in sedimentation rates at about 115,000 years ago, at which time the present rates changed from higher to lower values. The ridge sediments were composed primarily of continentally derived materials, and there were no indications of solid phases being derived from the weathering of the ridge itself or from volcanic activity. The equatorial samples have mineral assemblages which are distinctly different from those in deposits at higher latitudes, and which probably are indicative of contributions of materials from tropical weathering processes. (auth)

43795 MIGRATION OF RADIOGENIC STRONTIUM DURING METAMORPHISM. G. J. Wasserburg (California Inst. of Tech., Pasadena), A. L. Albee, and M. A. Lanphere. J. Geophys. Res., 69: 4395-4401(Oct. 15, 1964).

Study of the concentration and isotopic composition of strontium and rubidium in hornblende diorite dikes and sills of Precambrian age from the Panamint Mountains of California showed that these rock systems were enriched in radiogenic Sr during a late Mesozoic metamorphism. Enrichments in radiogenic Sr were observed for total-rock samples, which yielded apparent ages of up to 34,000 m.y., although there is no obvious petrographic evidence for such metasomatic changes. These results indicate that some caution is necessary in interpreting the Sr isotopic composition of rocks in terms of their original source or in assuming that "total rocks" form closed systems. In general, the initial isotopic Sr composition should be determined, not assumed. (auth)

43796 PALAEOCLIMATIC SIGNIFICANCE OF δ-OXYGEN-18-TIME TRENDS OBSERVED BY OXYGEN ISOTOPIC ANALYSIS OF FRESHWATER LIMESTONES. Jon N. Weber (Pennsylvania State Univ., University Park). Nature, 203: 969-70(Aug. 29, 1964).

The carbonate-water paleotemperature technique whereby the temperature of calcium carbonate precipitation can be determined by measuring the oxygen-18 content of the calcite is discussed. This technique was not applied to fresh-water carbonates, presumably because of large present-day variations in the isotopic composition of fresh water. It is proposed that if enough samples of fresh-water limestones are used to suppress random error or variations, it should be possible to determine paleotemperatures for these carbonates. (C.E.S.)

43797 INFLUENCE OF STABLE Sr AND Ca ON Sr^{90} AND Ca^{45} IN SOILS AND CLAY MINERALS. H. Nishita and P. Taylor (Univ. of California, Los Angeles). Soil Sci., 98: 181-6(Sept. 1964). (TID-19659)

Experiments were conducted to study the influence of stable Sr and Ca on the behavior of tracer quantities of ^{90}Sr and ^{45}Ca in soils and clay minerals, using an equilibrium batch method. The sorption of tracer quantities of ^{90}Sr and ^{45}Ca depended on the concentration of the stable Sr and Ca and the kind of soil or clay mineral. Under conditions of low ionic concentration in the equilibration suspensions, more ^{90}Sr was sorbed in Ca systems than in Sr systems. Under conditions of relatively high ionic concentrations, there was no appreciable difference in ^{90}Sr sorption between Ca and Sr systems. Since the initial trace quantities of ^{90}Sr were sorbed firmly, the sequence of addition of the tracer to the soil in relation to stable Sr and Ca was important. (auth)

Natural Radioactivity and Fallout

Refer also to abstract 44357.

43798 (CEX-59.4.14) AERORADIOACTIVITY SURVEY (ARMS-I) AND AREAL GEOLOGY OF PARTS OF CENTRAL AND WESTERN MASSACHUSETTS, EASTERN NEW YORK, SOUTHERN VERMONT, AND SOUTHWESTERN NEW HAMPSHIRE. Peter Popenoe (Geological Survey, Washington, D. C. and Division of Biology and Medicine, AEC). 59p.

An airborne gamma-radiation survey of Connecticut, Rhode Island, and parts of New York, Massachusetts, New Hampshire, and Vermont was made during the period from 1958 through 1960. Results of the survey indicate that a wide range of natural radioactivity exists and that the levels are closely related to the type of bedrock underlying glacial material, and subordinately to the glacial material. A discussion is given of the radioactivity and the correlation of the data with the areal geology of the northern portion of the area surveyed. The southern portion of the area is discussed in CEX-58.4.6. The area was traversed with parallel flight lines flown 500 ft above the ground and spaced at 1-mile intervals. Continuous aeroradioactivity profiles were obtained with scintillation detection equipment installed in a twin-engine aircraft. A map of radioactivity units was prepared from the profiles. Parts of four physiographic provinces are included in the survey area: the Appalachian Plateau province underlain by relatively flat-lying Paleozoic shale, sandstone, and limestone; the Valley and Ridge province underlain by weakly folded Paleozoic shale, sandstone, limestone, and dolomite; and the New England and Adirondack provinces, underlain chiefly by highly deformed Precambrian and Paleozoic schist, gneiss, and amphibolite. Bedrock in the survey area is mantled with unconsolidated glacial deposits that range in thickness from 0 to more than 200 ft. Rocks of sedimentary and igneous origin produced high and low levels of radioactivity. Three large areas containing rocks of moderate to high radioactivity are present: one is associated with clastic rocks of Devonian age in the Helderberg Plateau and foothills of the Catskill Mountains: another is associated with phyllite and slate of Cambrian and Ordovician age in the Taconic Mountains and foothills; and a third is associated with a broad belt of phyllite, micaceous

quartzite, and intrusive igneous rock, chiefly of Devonian age, in New Hampshire and east-central Massachusetts. Low radioactivity is associated with a large massif of anorthosite in the Adirondack Mountains, large areas of the Precambrian complex of the Green and Adirondack Mountains, a broad belt of Cambrian, Ordovician, and Devonian schist, gneiss, and amphibolite in eastern Vermont; igneous rocks of the Oliverian Plutonic Series (Devonian?) in New Hampshire and Massachusetts, and glacial lacustrine deposits along the Hudson and Connecticut Rivers. (auth)

43799 (HW-SA-3688) STUDIES OF RADIOACTIVITY IN ALASKAN ESKIMOS BY URINALYSIS AND BY NON-SHIELDED WHOLE BODY COUNTING METHODS. H. E. Palmer (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Sept. 18, 1964. Contract AT(45-1)-1350. 11p. (CONF-747-1)

From 4th Symposium on Radioactivity in Scandinavia, Riso, Denmark, Oct. 1964.

The content of ^{137}Cs in urine samples of Alaska Eskimos was correlated with results of measurements of ^{137}Cs body burden as determined by whole-body counting. Data on the ^{137}Cs content during the first half of 1964 are presented. High concentrations of ^{22}Na observed in urine samples collected in March and April were traced to ^{22}Na in caribou meat consumed by the subjects. The ^{22}Na content was so large that the ^{40}K content could not be used to determine K, and the K had to be determined by flame photometry. (C.H.)

43800 (INS-R-25) THE EXAMINATION OF SULPHUR ISOTOPIC RATIOS IN THE GEOTHERMAL AND VOLCANIC ENVIRONMENT. T. A. Rafter and S. H. Wilson (New Zealand. Inst. of Nuclear Sciences, Lower Hutt). [1963]. 59p.

A discussion is given of methods for collection of samples from geothermal bores, fumaroles, and hot springs for sulphur isotope abundance measurements. A complete quantitative chemical analysis is proposed for the estimation of all forms of sulphur found in volcanic discharge and their isolation for sulphur isotope measurements. Results are presented for nineteen bores in the Wairakei Geothermal Area, three fumaroles on the volcano, White Island, and nine hot springs selected throughout the North Island volcanic region. The results are discussed and methods are given for calculating the average sulphur isotope abundance for a geothermal bore given the well-head pressure, sampling pressure, and chemical and isotopic data. Evidence is presented suggesting that the present isotopic ratio of oceanic sulphate could be due to chemical and bacterial mechanisms that produce both sulphate and H_2S. Furthermore, the isotopic ratio of the H_2S produced could explain the variations in sulphur isotope ratios in sulphide minerals. (auth)

43801 (LA-3132-MS(p.145-52)) CONTAMINATION OF MATERIALS OF CONSTRUCTION. E. C. Anderson, P. N. Dean, and M. W. Rowe (Los Alamos Scientific Lab., N. Mex.).

Gamma contamination of commercially available Pb sheet and steel, the materials used to shield low-level γ counters was studied. Samples of Pb sheet were compared with two reference samples prepared from old Pb. Data on the ^{210}Pb content in Pb sheet are included. Ruthenium-106 was the principle contaminant found in recently produced steel. Samples of non-active steel were found. (C.H.)

43802 (MIT-952-1(p.196-262)) BEHAVIOR OF RADON^{222} IN THE NATURAL ENVIRONMENT. (Massachusetts Inst. of Tech., Cambridge. Radioactivity Center).

Preliminary data are presented from a study of the effects of an applied ambient overpressure on the ^{222}Rn characteristics of an underground uranium mine environment. Measurements were made of the Rn diffusion coefficient through the interstices of unconsolidated alluvium, glacial till, and consolidated sandstone and the Rn and Ra content in recycle mine waters as an indication of leaching of Ra and U from rocks and the extent of Rn introduction to a mine by recycle water. (C.H.)

43803 (MLM-1210) ENVIRONMENTAL MONITORING SEMI-ANNUAL REPORT: JANUARY THROUGH JUNE, 1964. P. C. Adams (Mound Lab., Miamisburg, Ohio). July 24, 1964. Contract AT(33-1)-Gen-53. 16p.

Data are presented on the concentration of radioactive materials detected in the environment surrounding Mound Laboratory, Miamisburg, Ohio, during the first half of 1964. The concentration of polonium and tritium in the Great Miami River was within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. The concentration of polonium and plutonium in the environmental air was also within the maximum permissible level recommended by the National Committee on Radiation Protection and Measurements. There was no detectable concentration of tritium in the environmental air during this period. (auth)

43804 (NP-14320) DATA FROM RADIATION PROTECTION PROGRAMS. Volume 2, No. 6. (Canada. Dept. of National Health and Welfare. Radiation Protection Div., Ottawa). June 1964. 49p.

Data are presented on radioactivity due to fallout in samples of air, precipitation, milk, wheat, soil, and human bone collected in Canada during April and May 1964. Data are included from reactor environment monitoring, personnel dosimetry, isotope safety assessment, and field investigations of radiation safety. (C.H.)

43805 (TID-3909(Suppl.2)) AN ATOMIC RADIATION BIBLIOGRAPHY. A List of Reports Submitted to the United Nations Scientific Committee on the Effects of Atomic Radiation (Supplement 2). Alfred W. Klement, Jr., comp. (Division of Biology and Medicine, AEC). June 1964. 25p.

A list is presented of 175 reports submitted to the United Nations Scientific Committee on the Effects of Atomic Radiation by member governments and certain international agencies and organizations between May 1962 and June 1964. Subject matter emphasis is on environmental levels of radiation and fallout. (C.H.)

43806 (URS-640-4) THE FEASIBILITY OF AERIAL PHOTOGRAPHIC DETECTION OF FALLOUT. Final Report. Myron B. Hawkins (United Research Services, Inc., Burlingame, Calif.). May 29, 1964. Contract OCD-PS-64-2. 47p. (AD-601215)

A preliminary study was conducted to determine the feasibility of detecting fallout deposits after a nuclear attack using aerial photographs. The investigation included: (1) study of selected characteristics of fallout; (2) analysis of existing aerial photographs taken at nuclear tests; (3) investigation of the general capabilities of modern aerial reconnaissance techniques; (4) demonstration of the detectability of two types of synthetic fallout using aerial photographs; and (5) analysis of the potential of aerial reconnaissance for fallout detection. The prin-

cipal conclusion on the basis of the photographic evidence was that a limited detection capability exists at present even under uncontrolled conditions. It was also concluded that the detection and identification capability can be improved by the development of photographic techniques that exploit the reflectance differences between fallout and various contrasting surfaces, and that the capability to quantify the fallout deposit mass by comparative means can be developed. (auth)

43807 RADIOACTIVITY OF SOME SPRINGS, MUD AND THERAPY ROOMS FROM EUGANEAN THERMAL ZONE. G. G. Calapaj and D. Ongaro (Università, Padua). Acta Isotopica, 3: 349-66(1963). (In Italian)

A study was carried out on the radioactivity of some springs, mud and therapy rooms from the Euganean thermal zone, which includes the towns of Abano, Montegrotto, and Battaglia in the district of Padua (Italy). The usual barium sulfate method for precipitating Ra from water was modified and standardized in order to put in evidence, beside Ra, the products of the disintegration chain starting from Rn, present in the springs at the moment of their outflow. Content of Ra in thermal water ranges from about 20 to 170 pC/l. Some springs contain a rapidly decreasing initial alpha activity, which is much greater than that compatible with the actual radioactive equilibrium. This initial hyperactivity has been recognized to be due to descendents of Rn and partly to Rn itself, that the water should have previously dissolved by coming from or crossing layers of radiferous rocks. Because of the high temperature and the fall of hydrostatic pressure, Rn is partly released in the atmosphere leaving in the water its disintegration products. Through gamma spectrometry no natural radionuclides, but Ra, were demonstrated either in water or in mud. Content of Ra in mud appeared to range from about 6,000 to about 30,000 pC/kg, depending largely from several physicochemical factors not yet quite clear. The people working in the proximity of springs or swimming pools of thermal water, tanks of mud, or in therapy rooms get radiation doses not exceeding the maximum permissible stated by I.C.R.P. (auth)

43808 THYROID GLAND INDICATING AMOUNT OF RADIOACTIVE FALLOUT. Jean Moore and Lucien Richou (Service Veterinaire du Departement de la Seine, Paris). Bull. Acad. Vet. France, 36: 61-7(Jan. 1963). (In French)

The use of the thyroid gland to evaluate the amount of radioiodine fallout was investigated in bovines. The animals were scarificed and the ^{131}I content was measured. The values obtained were compared with the fallout measured in rain water during the same period. The agreement between the two series of measurements indicated that the activity of the thyroid gland can be a good measurement of the fallout in a given region. (J.S.R.)

43809 ANALYSIS OF RADIOACTIVE ARKOSES AROUND ERLANGEN USING GAMMA SPECTROMETRY. W. Klein. Erlanger Geol. Abhandl., No. 37, 21-5(1961). (In German)

Gamma spectrometry was used to analyze the radioactive arkoses around Erlangen. The results showed that the activity of the samples studied originated almost exclusively from ^{238}U series. Only an extremely small fraction could be attributed to the ^{232}Th series. The ^{40}K content present in most minerals was superposed by the other radioactivity. (tr-auth)

43810 THE COMPOSITION AND SPATIAL DISTRIBUTION OF BACKGROUND RADIATION. Stewart C. Bushong (Univ. of Pittsburgh). Health Phys., 10: 731-42(Oct. 1964).

An investigation of the background radiation at Presbyterian-University Hospital, Pittsburgh, was conducted as a preliminary step to the construction of a whole-body counter. Measurements employing a NaI(Tl) scintillation crystal and a 400-channel pulse height analyzer revealed no contribution from man-made sources to the total background radiation. Scans obtained on the ground floor of the hospital showed a relatively constant distribution of gamma ray intensity as a function of direction. Analyses of building material and earth borings showed average concentrations of 1.08 pC Ra/g and 0.202 pC ^{40}K/g but showed no simple relationship between activity and the depth of the sample. Variations of air activity are also described. In terms of detector interactions, the naturally occurring isotopes in the uranium and thorium series are shown to contribute about 90% of the total activity to an unshielded detector, while 90% is ascribed to ^{40}K and the remaining activity to cosmic radiation. (auth)

43811 ANALYSIS OF GAMMA-RAY SPECTRUM OF RADIOACTIVE FALLOUT OVER CALCUTTA. Sushil Kr. Das, Prabir K. Sandell, R. C. Sastri, and S. D. Chatterjee (Jadavpur Univ., Calcutta). Indian J. Phys., 38: 118-20 (Feb. 1964).

The corrected gamma spectra of a sample of rainborne radionuclides was analyzed, and the radioisotopes identified from the spectra are tabulated. (C.E.S.)

43812 FOURTH REPORT OF THE FEDERAL RADIATION COUNCIL. W. S. Snyder. Nucl. Safety, 5: 323-5 (1964).

Estimates of radiation levels, doses, and biological effects of nuclear-device testing from Jan. 1962 through Mar. 1963 are summarized in the report. More data are presented on fallout than were given in previous reports. An analysis of fallout data is included. (J.R.D.)

43813 SURVEY OF RADIOACTIVE FALLOUT. ANNUAL REPORT FOR 1963. Man Sik Kang, Hack Pil Chung, Chang Suk Kim, and Sung Joo Lee. Rept. Army Res. Testing Lab., 2: 87-90(1963). (In Korean)

Activity of radioactive fallout was measured at this laboratory in 1963. The results are summarized. Gross beta-activity of rainwater varied from 64.9×10^{-4} to 0.37×10^{-4} μc/liter. It revealed spring maximum and decreased at the end of the year. Gross beta-activity of fallout dust ranged from 99.1×10^{-4} to 1.1×10^{-4} $\mu C/m^2$-day and was $\sim 10^{3}$ $\mu C/m^2$-day on an average. Maximum activity was found in June and activity decreased gradually at the end of the year. Total dry deposition was about 800 mC/km^2 and was slightly low value as compared with that of last year. This is supposed to be attributed to stratospheric fallout due to the nuclear explosion tests in 1961 and 1962. (auth)

43814 STUDIES ON RADIOACTIVE AIRBORNE DUST. PART I. SEASONAL VARIATION OF GROSS BETA-ACTIVITY AND ANALYSIS OF LOW ENERGY GAMMA-EMITTERS BY MEANS OF SPECTROMETER. Man Sik Kang, Hack Pil Chung, and Byung Ki Sohn. Rept. Army Res. Testing Lab., 2: 91-6(1963). (In Korean)

Results obtained by studying airborne dust collected at this laboratory in 1963 are reported. Short half-life of beta-emitters in airborne dust was about 10 hours; whereas long half-life was about 1 month on an average. Gross beta-activity of airborne dust consisted mainly of short half-life nuclides. Gross beta-activity of airborne dust was about 6.5 pc/m^3 throughout the year. It revealed somewhat irregular and low activity in rainy season.

Natural radioactive gamma-emitters, ^{212}Pb, ^{208}Tl, ^{214}Pb, and ^{214}Bi were found as low energy nuclides in airborne dust and most of the gamma-activity was due to ^{212}Pb. Detection of artificial radioactive nuclides in airborne dust was impossible because of their low activity compared with that of natural radioactive nuclides. (auth)

43815 BOMB TESTS. WHAT KIND OF RADIOACTIVE FALLOUT AND HOW MUCH. Dan I. Bolef. Scientist Citizen, 6: Nos. 9-10, 8-12(Sept.-Oct. 1964).

Fission products produced by nuclear weapons are discussed in terms of their biological importance. The influence of testing and the test ban treaty on levels of ^{131}I, ^{89}Sr, ^{90}Sr, ^{137}Cs, and ^{14}C in fallout are considered. (H.M.G.)

43816 RADIOIODINE — ITS UPS AND DOWNS. Robert Wurtz. Scientist Citizen, 6: Nos. 9-10, 34-7(Sept.-Oct. 1964).

Fluctuations of ^{131}I levels in fallout are considered in terms of testing and the test ban treaty. Advantages of the FRC's new Protective Action Guide are compared to the older FRC publication Radiation Protection Guide. (H.M.G.)

43817 UMWELTRADIOAKTIVITAT UND STRAHLENBELASTUNG. BERICHT IV/63. (Environmental Radioactivity and Radiation Burden. 4th Quarterly Report, 63). Bad Godesberg, Ger., Bundesminister fur Wissenschaftliche Forschung, 1964. 160p. 7.-DM.

The results of measurements of the radioactivity in air, water, earth, and foods and the radiation burden of the population in the West German Republic are tabulated for the last quarter of 1963. (J.S.R.)

43818 REVISED FALLOUT ESTIMATES FOR 1964–1965 AND VERIFICATION OF THE 1963 PREDICTIONS. Report No. 6. (Federal Radiation Council, Washington, D. C.). Oct. 1964. 31p. $0.25(GPO).

On the basis of information available in June 1964, new estimates of the levels of fallout expected in 1964 and 1965 from the atmospheric testing of nuclear weapons conducted through 1962 have been made by the Federal Radiation Council. Based on the stratospheric inventory of strontium-90 in January 1964, the predicted annual depositions in 1964 and 1965 have been increased by 50 percent over those presented in FRC Report No. 4. This adjustment is well within the expected uncertainty of the original estimate and does not change the 30-year and 70-year dose estimates made on the basis of the original predictions. The inventory of long-lived fission products such as strontium-90 and cesium-137 in the atmosphere by mid 1964 was reduced to one-half that in January 1963. The deposition of fallout in the United States in 1963 was very close to the predicted values. The average deposition in the "wet" areas was a little less than predicted and that in the "dry" areas a little more. The time of maximum deposition occurred about a month later than it has in previous years. Iodine-131 from the atmospheric testing of nuclear weapons had disappeared by May 1963 and strontium-89 by June 1964. The observed levels in 1963 for strontium-89, strontium-90, and cesium-137 in milk and dairy products, short-lived nuclides leading to external exposure, and carbon-14 in the atmosphere at ground level were all very close to the values predicted in FRC Report No. 4. The observed values of strontium-90 in the total diet and in new bone were less than predicted for 1963. This discrepancy is considered to result from the fact that some non-dairy products, particularly cereal grains, do not enter the diet in significant quantities in the same year in which they are grown. New predictions for the strontium-90 and cesium-137 levels in milk, and strontium-90 in cereal grains and the total diet expected in 1964 and 1965 have been made to reflect the adjusted annual fallout level and the lag time for cereal grain products to enter the diet. These predictions are that the levels of long-lived radionuclides in milk in 1964 will be about the same as they were in 1963. The strontium-90 concentrations in the total diet in 1964 are expected to be higher than they were in 1963 and to drop to 1963 levels in 1965. Based on the predictions of dietary contamination levels anticipated in 1963 and subsequent years, the Council concluded in FRC Report No. 4 that the health risks from radioactivity in food over the next several years are too small to justify protective actions to limit the intake of radionuclides by diet modifications or altering the normal distribution and use of food, particularly milk and dairy products. The present study has shown that the predictions in FRC Report No. 4 were substantially correct, and the conclusions in that report still apply. (auth)

43819 RADIOACTIVE SODIUM ISOTOPES IN ATMOSPHERE. W. Roedel. 6p. (CONF-337-16). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The apparatus used for the measurement of ^{22}Na and ^{24}Na in rain and in the atmosphere near the ground is described. The results obtained for ^{22}Na in rain since 1962 are reported and are comparable to the evaluation of its production by cosmic radiation. In the summer of 1963 the concentration increased as a result either of meteorological factors or nuclear tests. In the summer of 1963 three samples of ^{24}Na were detected and measured. (J.S.R.)

43820 STUDY OF DIRECT EXCHANGE BETWEEN THE ATMOSPHERE AND THE SURFACE OF THE EARTH. Nguyen Ba Cuong, R. Chesselet, G. Lambert, and D. Nordmann. 12p. (CONF-337-19). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The study of the activities of air samples collected at Saclay led to the determination of the mean daily value of dry fallout, which should be considered as a relative part of the total fallout even when there is precipitation. Cleaning of the air by the action of vegetation and of the soil was shown by comparing the artificial radioactivity of the lower atmosphere in different types of regions, such as forests, high mountains, and ocean surfaces. The role of vegetation in the cleaning of the air is affected by the type of vegetation and numerous meteorological factors. However, the amount of radiation accumulated in the ocean is never lower than that accumulated on adjacent continents, which suggests a fundamental difference between the continents and the oceans in the exchanges between atmosphere and soil surface. (J.S.R.)

43821 METHOD OF DIFFERENTIAL COLLECTION OF RADIOACTIVE FALLOUT. E. Nagel and P. Courvoisier. 7p. (CONF-337-47)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The use of plexiglass plates covered with vaseline for the collection of fallout of all kinds in the vicinity of reactors was investigated. The reproducibility was found to be good. The fallout, after it is fixed on the vaseline, was not released. The vaseline did not, however, collect efficiently the fallout in precipitations. In order to collect all the fallout, the vaseline-covered plexiglass must be combined with a rain collector. The values of the dry fallout were compared. It was evident that the rain collector also received some of the dry fallout. (J.S.R.)

Site Survey and Selection

43822 (GA-3997) SURVEY OF FACTORS INFLUENCING SITE SELECTION AND PHYSICAL ARRANGEMENT OF NUCLEAR RESEARCH CENTERS EQUIPPED WITH A RESEARCH REACTOR. A. P. Graff, T. A. Johnston, and G. T. Schnurer (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Feb. 1963. Contract AT(04-3)-167. 13p.

Observations are given on the criteria influencing the final selection and layout for a nuclear research center. Emphasis is placed on the short- and long-range goals of the center. Regional siting and safety criteria are discussed. A checklist of the factors to be considered in selecting a site is given. Some existing centers located in populated areas are also listed to demonstrate the feasibility of urban sites. (D.L.C.)

Techniques and Equipment

43823 ON THE PRESERVATION OF RADIOGENIC ARGON IN HORNBLENDE. F. I. Kotlovskaya (Univ. of Geology, Kiev). Geokhimiya, No. 8, 828-30(1964). (In Russian)

The thermal stability of argon in hornblende was studied in order to determine absolute age by the argon method. Parallel studies were also made of biotite, which is widely used in rock dating. Both specimens were heated for 8 hr at 300 to 1000°C. The hornblende suffered considerably smaller changes. The main loss of argon was caused by dehydration. (R.V.J.)

43824 DETERMINATION OF SOURCE PARAMETERS OF EXPLOSIONS AND EARTHQUAKES BY AMPLITUDE EQUALIZATION OF SEISMIC SURFACE WAVES. I. UNDERGROUND NUCLEAR EXPLOSIONS. M. N. Toksoez, A. Ben-Menahem, and D. G. Harkrider (California Inst. of Tech., Pasadena). J. Geophys. Res., 69: 4355-66(Oct. 15, 1964).

A method of determining the source parameters of explosions and earthquakes from the amplitude spectra of seismic surface waves is described. The method, called amplitude equalization, involves the correction of the ground displacement spectrum for the propagation effect. This is accomplished by multiplying it numerically with the inverse of the frequency response of the layered medium. The result is the amplitude spectrum of the source function, which may be interpreted by itself or jointly with the initial phase spectrum to determine the source-time variation. The spectra of the Rayleigh waves from underground nuclear explosions are compared and the source-time function is interpreted using the amplitude equalization method. The time variation of the pressure pulse at the boundary of the elastic zone is found to be of the form $p(t) = P_0 t e^{-\eta t}$, where η is a parameter which depends on the yield of the explosion and on the medium. For the events studied, the breadth of the pulse increased (η decreased) with the yield of the explosion. (auth)

43825 THE EFFICIENCY OF LOCATING COPPER SULFIDE ORES IN A WELL PROFILE BY NEUTRON ACTIVATION LOGGING. E. M. Lobanov, A. P. Norikov, G. S. Nikanorov, O. M. Romanov, and A. A. Khaidarov. p.116-25 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

The equipment lowered into the well consisted of two steel containers connected to each other by a steel bar whose length could be varied. A 20-C Po–Be source was placed in the lower container, and a small γ scintillation detector with a NaI(Tl) crystal, voltage converter, and cathode repeater was put in the upper container. The NaI counter was connected by a cable with an amplitude analyzer at ground level. The well logging was carried out by allowing the Po–Be neutron source to irradiate the wall at a definite depth for 15 minutes. Then the source was lowered a probe length of 3 m, and the γ detector was placed opposite the irradiated place, while the neutron source was irradiating another position 3 m lower. Thus, it required 15 minutes to carry out an analysis at one point. A total of 700 points were analyzed for copper in a number of exploratory wells by measuring the 1.05-Mev γ ray of ^{66}Cu at a channel width of 5 to 10 volts. The concentration of copper varied from 0.4 to 0.6% in the zone of primary ore to 13.0% in the oxidation zone. A correlation equation was developed, which relates the measured gamma intensity I_γ with the copper concentration K. The activation analyses agreed with the data of chemical analyses. The average deviation was about 10%. It was concluded that neutron activation logging readily detects copper sulfide mineralization of the more important oxidized copper ores. (TTT)

43826 DETERMINATION OF COPPER CONTENT OF DRILLED HOLES BY MEANS OF ACTIVATION LOGGING. E. M. Lobanov, A. P. Novikov, G. S. Nikanorov, and A. A. Khaidarov. p.126-37 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

A total of over 1500 copper analyses in disseminated ores was carried out by counting the 1.04-Mev γ peak of the induced ^{66}Cu activity (half life of 5.1 min) with a NaI(Tl) scintillation counter. After correcting for the induced ^{28}Al activity (half life of 2.3 min), the data were examined in order to introduce corrections for the diameter of the well, the presence of a well casing, activity decay of the ^{210}Po source, and the natural radioactivity of the soil. With a copper concentration of 0.22%, the decrease in activity was 27% for a cased well with a diameter of 130 mm compared to an uncased well with a diameter of 110 mm. The correction for the change in diameter was 13%, and it was 14% for the presence of a casing. The induced activity had to be corrected for the decay of ^{210}Po in the source, which has a half life of 138 days. The background due to natural radioactivity was subtracted from the induced activity. The average error between the data from activation logging and chemical core analyses for copper was 7%. The activation method was more effective for use in estimating the copper reserve of a deposit. (TTT)

Thorium and Uranium Minerals

43827 RE-EXAMINATION OF ISOTOPIC RELATIONSHIPS IN COLORADO FRONT RANGE URANIUM ORES. P. O. Banks and Leon T. Silver (California Inst. of Tech., Pasadena). Bull. Geol. Soc. Am., 75: 469-76(May 1964).

Some new isotopic analyses of Front Range pitchblende samples and comparisons with published data indicate a complex history of isotopic disturbance in these ores. Relationships in the $^{238}U-^{206}Pb$ and $^{235}U-^{207}Pb$ systems indicate extensive and protracted mobilizations of parents and daughters, and particularly intermediate daughters, in both isotopic series. These relationships preclude a simple, much less unique interpretation of the absolute

age of the uranium mineralization in the Front Range. Considering the lack of close definition in the stratigraphic age assignment for this mineralization, it is suggested that the common use of the inferred age in the construction of geologic time scales is not justified. (auth)

43828 THE INCORPORATION OF URANIUM AND SILVER BY HYDROTHERMALLY SYNTHESIZED GALENA. Joseph J. Hutta and Harold D. Wright (Pennsylvania State Univ., University Park). Econ. Geol., 59: 1003-24(Sept.-Oct. 1964).

The occurrence of abnormal amounts of uranium in base metal sulfides associated with uraninite in vein deposits has suggested their use as a guide in uranium exploration. To aid in evaluating the potential usefulness of such a guide, an experimental study was undertaken in an attempt to determine the role of the uranium in the sulfides, and the factors that control the amount incorporated. Crystals of galena were grown hydrothermally in the presence of uranium over a range of temperature at constant pressure. Uranium concentration in the resulting crystals was determined radiometrically, and the distribution of uranium was studied by means of autoradiographs. For comparison, the solubility of silver—an element capable of trace level substitution in galena—was investigated under the same crystal growth conditions using the radioisotope Ag-110 as a tracer. It was found that appreciable amounts of uranium are incorporated by galena crystals during their growth, the amount being dependent on the temperature of crystallization. On the other hand, previously crystallized galena subjected to uranium-bearing hydrothermal solutions takes up uranium only in cleavages; solid diffusion is negligible within the time limits of experimentation. In natural samples, this feature may serve to differentiate introduced uranium from that incorporated during crystallization. The amount of uranium incorporated ranged from 900 ppm at 215°C to less than 100 ppm at 500°C. The inverse temperature relationship suggests that the uranium is not present in solid solution. In sharp contrast with the behavior of uranium, galena crystallized from silver-bearing solutions showed a systematic increase in Ag_2S content from 0.03 mole percent at 300°C to 0.52 mole percent at 600°C. These results demonstrate that the crystal growing technique used is applicable to a system in which solid solution occurs, and support the interpretation that uranium was not incorporated in solid solution in the usual sense. (P.C.H.)

43829 GEOLOGY AND LITHOLOGY OF URANIUM-BEARING BURG SANDSTONE OF ERLANGEN AND SURROUNDINGS. Wilhelm Haarlaender and Walter Alexander Schnitzer. Erlanger Geol. Abhandl., No. 37, 1-20 (1961). (In German)

The stratigraphy of the uranium-bearing sandstones of the area was determined. Radiometric measurements were made, and the methods used are reported. Configuration and distribution of the activity in the stratigraphic profile were measured. The paleography and boundaries of the radioactive sandstone were also determined. (J.S.R.)

43830 ON THE URANIUM, THORIUM AND POTASSIUM CONTENT IN SEDIMENTARY ROCKS AND THEIR ROLE IN THE GENERAL GAMMA-ACTIVITY. R. M. Kharitonova (Kazan Inst. of Geology). Geokhimiya, No. 8, 831-5(1964). (In Russian)

A scintillation spectrometer was used for determining U, Th, and ^{40}K in cores from Tatar poleosoic formations. The contents of radioactive elements were measured using the intensities of the 0.9-Mev (MsTh), 1.45-Mev (^{40}K) and 1.76-Mev (RaC) γ lines. The maximum contents were found in argyllites: 20.4×10^{-4}% U, 63.5×10^{-4}% Th, and 5.4% ^{40}K. (R.V.J.)

43831 RELATIVE DISTRIBUTION OF THORIUM, URANIUM AND LEAD ESTIMATED FROM THE ISOTOPIC COMPOSITION OF LEAD IN ORES. Akimasa Masuda (Tokyo Univ.). Nature, 203: 1062(Sept. 5, 1964).

An empirical formula for the relative distribution of ^{238}U, ^{232}Th, and ^{204}Pb in ores is derived. (C.E.S.)

43832 WORLD RESERVES OF URANIUM AND THORIUM. R. L. Faulkner and J. W. Gabelman. Nucl. News, 7: No. 10, 102(Oct. 1964).

A comparison is made of estimated uranium requirements and reserves available during the 1964-1970 period to give some indication of the amount of uranium needed to result from new exploration. World thorium reserves are discussed, and it is concluded that low-cost thorium should be amply available during the next 35 years. (C.E.S.)

HEALTH AND SAFETY

Refer also to abstracts 43151, 43159, 43821, 44918, and 45094.

43833 (LA-3132-MS(p.153-69)) CESIUM-137 BODY BURDENS OF CONTROL SUBJECTS. P. N. Dean and R. L. DePriest (Los Alamos Scientific Lab., N. Mex.).

Data are presented from monthly measurements of the whole-body ^{137}Cs content in residents of New Mexico from June 1963 through May 1964. The ^{137}Cs content continued to rise in 1963 until December, when a slight drop was observed. In January 1964 the level started to rise again and continued to rise to a level of 114 pC/gm K in May 1964. Comparative data from 1959 are included. (C.H.)

43834 (CEA-tr-A-1514) VETEMENT PROTECTEUR DESTINE PARTICULIEREMENT A LA PROTECTION CONTRE LES POUSSIERES DE MATIERES RADIOACTIVES. (Protective Clothing Designed Especially for Protection Against Dusts of Radioactive Materials). B. Hensel. Translated by M. Carbonnier (France. Commissariat a l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay), from German Patent 1,126,253. Mar. 26, 1964. 5p.

Protective clothing, designed especially for protection against radioactive dusts, is described. The sleeves are provided with tight or elastic cuffs on which the gloves are threaded. (J.S.R.)

43835 RADIATION MONITORING ON PROJECT MERCURY: RESULTS AND IMPLICATIONS. Hermann J. Schaefer (Naval School of Aviation Medicine, Pensacola, Fla.). Aerospace Med., 35: 829-33(Sept. 1964).

On Missions MA-8 and MA-9 two special circumstances called for closer attention to radiation exposure. These were the artificial radiation belt of electrons created in the high altitude nuclear explosion of July, 1962 (Starfish Test) and the residual proton flux of the Inner Van Allen Belt reaching down to satellite altitudes in the South Atlantic Anomaly. Ilford G-5 emulsions flown on MA-8 and MA-9 showed a background from electrons and gamma rays not significantly different from that of the sea level controls indicating that the inherent shielding of the capsule was sufficient for complete absorption of electrons from the artificial radiation belt. The emulsions did show large populations of low energy protons picked up in the South Atlantic Anomaly. Evaluation by track and grain count furnished the differential energy spectrum of these protons and lead to an absorbed dose of 27 milliRads, an RBE dose of 31 milliRems, and a QF dose of 41 milliRems. The additional exposure from all other sources, i.e., from heavy nuclei, disintegration stars, and meson events was estimated at 2 milliRads. The most significant result of the measurements was the absence of electrons and gamma rays as contributors to the additional dose in the flown emulsions as compared to the sea level controls. It indicated that the primary cosmic ray beam produces, in one and a half tons of compact material of the Mercury capsule, only an insignificant amount of electrons and gamma rays. (P.C.H.)

43836 INACTIVATION OF AIRBORNE VIRUSES BY ULTRAVIOLET IRRADIATION. Marcus M. Jensen (Univ. of California, Los Angeles). Appl. Microbiol., 12: 418-20 (Sept. 1964).

Aerosolized viruses were passed through a high-intensity ultraviolet (uv) cell. This cell consisted of a long cylindrical aluminum tube [diameter, 7 in. (17.7 cm); length, 36 in. (91.4 cm)] with a highly reflective inner surface and a longitudinally extending helical baffle system which directed airborne particles in close proximity to a centrally located uv lamp. After having been passed through the uv cell, viral aerosols were collected with an Andersen sampler, and viral concentrations were determined by plaque assay methods on tissue cultures. Inactivation rates of greater than 99.9% were obtained for Coxsackie, influenza, Sindbis, and vaccinia viruses, and slightly less for adenovirus (96.8%), when the aerosols passed through the uv cell at 100 ft^3/min. At aerosol flow rates of 200 ft^3/min, inactivation rates were slightly lower; 91.3 for adenovirus, 97.5 and 96.7 for Coxsackie and Sindbis, respectively, and greater than 99.9% for influenza and vaccinia viruses. (auth)

43837 PROBABLE BERYLLIOSIS FROM BERYLLIUM ALLOYS. Jan Lieben (Pennsylvania Dept. of Health, Harrisburg), John A. Dattoli, and Harold L. Israel. Arch. Environ. Health, 9: 473-7(Oct. 1964).

Three cases of probable berylliosis from working with low beryllium content alloys are reported. The cases occurred in a foundry and in a pattern works. Thirteen other cases of berylliosis caused by working with alloys are quoted from the literature. Low concentrations of beryllium alloys have, in the past, been regarded as innocuous, and routine precautions are frequently ignored particularly since earlier literature confirmed the erroneous idea of nontoxicity. Air samples where low concentration beryllium alloys were handled are reported and were above the generally accepted threshold limit values in two of three factories. The diagnostic difficulties between berylliosis and sarcoidosis are discussed, and the need for more rigid precautions is stressed. (auth)

43838 HUMAN EXPOSURE TO EXTERNAL BACKGROUND RADIATION. Ascher Segall and Robert Reed (Public Health Service, Boston). Arch. Environ. Health, 9: 492-9(Oct. 1964).

A survey of population exposure to external background radiation in relation to bedrock radioactivity was conducted in Vermont and New Hampshire from July 18 to Aug. 28, 1962. The weekly dose rate received by 400 persons matched for occupational category was measured using condenser chamber pencils and a pulse height read-out unit. The study comprised urban and rural areas in eight radiogeological categories ranging in bedrock radioactivity from an equivalent uranium concentration of 5 ppm to 45 ppm. The mean weekly dose rates ranged from 2.29 to 3.28 mR/week. Significant variation between the dose received by individuals residing in the same area was observed. This did not appear to be related to occupational category. There was significant correlation between bedrock radioactivity and the mean population dose rate. (auth)

43839 HEALTH PROGRAM FOR RADIATION WORKERS. W. D. Norwood (General Electric Co., Richland, Wash.). Arch. Environ. Health, 9: 529-35(Oct. 1964). (HW-SA-3391)

The hazards of radiation to the worker are similar to those in the chemical or other hazardous industries but there are some notable differences. Since any exposure to radiation, no matter how small, may be injurious, ex-

posure should be reduced to the minimum practicable level. The establishment of radiation protection guides represents an effort to balance the biological risk against the benefits to be derived from the use of radiation. Elements of concern in estimating the biological risk are considered. Such data provide proper perspective in determining how the pattern of the conventional occupational health program may be modified to accommodate the new dimensions. (auth)

43840 RESPIRATORY PROTECTION IN AN ATOMIC CENTRE. J. Rodier, J. Chassany, and G. Langlet. Arch. Maladies Profess. Med. Trav. Securite Sociale, 24: 787-802(Oct.-Nov. 1963). (In French)

A description is given of the protective system instituted at the French Atomic Center at Marcoule, which includes the detection of radioactive aerosols, group protection and individual protection. The article defines the quality criteria for personal protective equipment and describes the measures included in various checking procedures and in equipment decontamination. (CIS abstracts)

43841 IONIZING RADIATION AND THE SST. Stanley R. Mohler. Astronaut. Aeronaut., 2: No. 9, 60-4; 67-8 (Sept. 1964).

Various types of ionizing radiations known to exist at or near supersonic transport (SST) altitudes (50,000 to 80,000 ft) and units of radiation-energy measurement are defined. Methods of controlling exposure to galactic and solar cosmic showers are considered. Changing the SST flight path to lower geomagnetic latitudes is determined to be one means for partially avoiding these periodic higher flux densities. Secondary radiations produced by nuclear cascades initiated by primary radiations are discussed in terms of shielding problems. Consideration of mechanisms and consequences of late somatic and genetic radiation effects yielded many implications for occupant selection for SST. The no-threshold concept is applied to radiobiological damage at SST flight levels. Use of radioprotective compounds and radiosensitizers is evaluated. It is concluded that the matter of exposure of SST occupants to ionizing radiation at cruise altitudes is largely a matter of two considerations: a value judgement based on the known degree of biological effects of ionizing radiation and the fact that little is known about the biological effects of the heavy particles present in the environment of the SST occupant. (H.M.G.)

43842 LUNG CANCER IN A FLUORSPAR MINING COMMUNITY. II. PREVALENCE OF RESPIRATORY SYMPTOMS AND DISABILITY. W. D. Parsons (McGill Univ., Montreal), A. J. de Villiers, L. S. Bartlett, and Margaret R. Becklake. Brit. J. Ind. Med., 21: No. 2, 110-16(Apr. 1964).

A survey of respiratory symptoms, lung function tests, and chest radiography was carried out among the fluorspar miners of St. Lawrence, Newfoundland, in whom the incidence of carcinoma of the lung was previously shown to be 25 times greater than for the rest of the province. The incidence of pneumoconiosis among the exposed population was low (1.93%), and the incidence of chronic bronchitis was comparable to that reported for miners elsewhere. These are dismissed as relevant factors in the high incidence of carcinoma. The relevance of smoking is less easy to assess; it is suggested that the prevalence of heavy smoking among the miners cannot be the sole factor responsible for the higher incidence of carcinoma compared with the rest of Newfoundland, but it might well be a contributory one. It appears, therefore, that the main factor causing the high incidence of carcinoma among these miners was the high level of radioactivity in the air and water in the mines. The reduction in lung function tests appeared to be more closely related to the presence of bronchitis than to dust exposure, but the incidence of chronic bronchitis was apparently higher in men exposed for any length of time to dust risk than in men with insignificant exposure. (Public Health Eng. Abstr., 44: Sept. 1964)

43843 CUTTING WHEEL RESIDUES IN PLUTONIUM WASTE CAUSES EXPLOSION. Donald R. McFee and Howard V. Rhude, Jr. (Argonne National Lab., Ill.). Health Phys., 10: 757-60(Oct. 1964).

An explosion shattered a bell jar being used to oxidize waste from a plutonium cutting operation. The explosive materials were found to be flammable decomposition products (hydrogen sulfide, hydrogen, and methane) from the organic binder in the cutting wheels. This incident demonstrated the need for ventilation and the need for close evaluation of operations that must be done in closed atmospheres. (auth)

43844 EVALUATION FOR EMERGENCY PLANNING OF HAZARDS FROM ACCIDENTS INVOLVING STOCKS OF RADIOACTIVE MATERIALS. J. E. Cook (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Health Phys., 10: 823-32(Nov. 1964).

In formulating plans to deal with possible accidents at a nuclear research establishment, relationships are needed between the quantities of radioactive materials held in buildings and the hazards which might develop downwind if the materials were involved in fires, explosions, or similar incidents. These relationships are considered in two stages. Figures are given for the amounts of some commoner radioisotopes which if released to atmosphere could give rise to exposure above defined reference levels necessitating urgent emergency action at distances up to 100 m from the point of release. These amounts are called site hazardous releases. The fractions of stocks of radioactive materials which might be released to atmosphere from a building under accident conditions are also considered, and these combined with the site hazardous release quantities are used to define site hazardous stocks. Comparisons between these figures and actual stocks held enable the buildings on a site to be classified in order of potential hazard. Consideration is also given to the contamination of milk and crops in the case of accidents involving strontium-89, strontium-90, iodine-131, and cesium-137. (auth)

43845 RADIOACTIVITY IN TOTAL DIET SAMPLES. Edwin P. Laug and James M. Dimitroff (Food and Drug Administration, Washington, D. C.). J. Assoc. Office. Agr. Chemists, 47: 821-3(Oct. 1964).

Data were compiled on the presence of strontium-90 and cesium-137 in total diet samples. Strontium-90 and cesium-137 contents in the total diet have shown a steady increase in the 1963 samples, with the highest values concentrated during the fall of 1963. (auth)

43846 CHRONIC BERYLLIUM DISEASE. A FOLLOW-UP STUDY. John A. Dattoli (Pennsylvania State Dept. of Health, Harrisburg), Jan Lieben, and John Bisbing. J. Occupational Med., 6: 189-94(Apr. 1964).

Follow-up studies on 37 cases of chronic beryllium disease first reported in 1959 and 1960 are reported. Five patients died, four are clinically unimproved (deteriorating) 24 are clinically improved, and two were lost to follow-up. In two cases the diagnosis was changed from chronic to acute beryllium disease. The encouraging fact of clinical

improvement in 24 cases is noted and the possible contribution of steroid therapy to this improvement is suggested. These observations confirm the difficulty of diagnosing beryllium disease and the need for observation over a prolonged period. Seven newly discovered cases are also described including three in-plant cases, one contact case, and three neighborhood cases. The in-plant cases had long latent periods up to 21 yr in one instance. Follow-up will continue on these cases. (Public Health Eng. Abstr., 44: Sept. 1964)

43847 A GUIDE FOR THE PROPER SHIPMENT OF RADIOACTIVE MATERIALS IN THE INTERNATIONAL RAILROAD FREIGHT TRAFFIC. H. H. Naumann. Mitteilungsbl. Strahlungsmessgeraete, 5: No. 11, 5-11(Feb. 1964). (In German)

The legal requirements governing the rail shipment of radioactive materials in international commerce are briefly summarized. Examples of shipping labels are given. A chart showing the lead thickness for ^{60}Co sources is presented. (J.S.R.)

43848 SAFETY IN THE NUCLEAR POWER INDUSTRY. Nucl. News, 7: No. 10, 98-101(Oct. 1964).

A summary is given of the Geneva Conference papers on siting practices and criteria, safety research and development, engineered safeguards and containment, the safety of prestressed concrete vessels, atmospheric dilution, health and environment physics, safety of fuel processing plants, transport of irradiated fuel, nuclear ship safety, and the cost of regulatory requirements. (C.E.S.)

43849 NUCLEAR SAFETY. Volume 5, Number 4. William B. Cottrell, ed. (Oak Ridge National Lab., Tenn.). Summer 1964. $0.70(GPO) (domestic), $0.90(GPO) (foreign). (One of the Technical Progress Reviews prepared quarterly for the Division of Technical Information, USAEC).

A total of 24 papers are presented concerning various aspects of nuclear safety. The papers are categorized under general safety criteria, accident analysis, control and instrumentation, plant safety features, consequences of activity release, and current events. Separate abstracts were prepared for each paper. (J.R.D.)

For abstracts of individual papers see: 43812, 43850, 43851, 43852, 43853, 43854, 43855, 43856, 43857, 43858, 43859, 44076, 44077, 44267, 44268, 44269, 44282, 44938, 44939, 44940, 44982, 45055, 45056, and 45158.

43850 PROGRESS IN AEROSPACE NUCLEAR SAFETY. R. B. Korsmeyer. Nucl. Safety, 5: 303-16(1964).

A review of current thinking and experimental results in the field is presented. Included are discussions concerning the SNAP reactors and generators, space propulsion reactors such as Kiwi and NRX, environmental studies, and a program for assessment of aerospace nuclear power system safety. (J.R.D.)

43851 IAEA MEETING ON RADIOLOGICAL SAFETY IN NUCLEAR MATERIALS MINING AND MILLING. Nucl. Safety, 5: 316-21(1964).

Information presented at the meeting is summarized. All of the main aspects of protection against health risks in the mining and milling of nuclear materials are examined, ranging from the medical and technical view of radiological protection to the management of radioactive waste and to the evolution of health standards and their enforcement. (J.R.D.)

43852 PORT SURVEYS FOR NUCLEAR SHIPS. S. I. Kaplan. Nucl. Safety, 5: 321-3(1964).

The potential hazards of port visits by nuclear ships are examined. It is noted that the site limitations for acceptable berths for the N. S. Savannah were derived from dose calculations using the maximum credible accident concept in a manner comparable to that used for land-based reactors. The site limitations established by dose calculations were translated into criteria for evaluating the suitability of available berths in parts, determining the time limit for removal following accidents, and selection of remote anchorages. (J.R.D.)

43853 RADIATION IN PERSPECTIVE. Chauncey Starr. Nucl. Safety, 5: 325-35(1964).

Aspects of the impact of radiation on American society are examined. The public health aspects of conventional power are compared with those associated with nuclear power. It is concluded that the public welfare is best served by the continued development and construction of nuclear power plants. (J.R.D.)

43854 RADIATION HAZARDS WITH RECYCLE PLUTONIUM FUELS. C. M. Unruh. Nucl. Safety, 5: 378-82 (1964).

An analysis of the radiation problems involved in processing recycle ^{239}Pu fuel is presented. Comment is included on modes of radionuclide generation, deposition in the body, and external dose rates. It is concluded that use of Pu for reactor fuel is feasible provided proper equipment and safety procedures are used. (J.R.D.)

43855 RADIATION HAZARDS OF RECYCLED ^{233}U–THORIUM FUELS. E. D. Arnold. Nucl. Safety, 5: 382-9 (1964).

An analysis of radiation problems involved in handling recycle ^{233}U and Th fuels is presented. Comment is included on refabrication methods, ^{233}U and Th generation and decay, gamma and neutron activity in ^{233}U, activity in Th, and calculated activity for typical processing situations. (J.R.D.)

43856 BEHAVIOR OF RELEASED FISSION PRODUCTS IN ACTUAL REACTOR INCIDENTS. C. J. Barton and G. W. Parker. Nucl. Safety, 5: 389-92(1964).

Information concerning reactor accidents is presented. The tabulated data are mainly concerned with fission-product behavior. It is noted that scanty data are available for some incidents and reporting personnel are encouraged to give more complete information. (J.R.D.)

43857 SAFETY IN PLUTONIUM HANDLING. R. E. Leuze. Nucl. Safety, 5: 392-6(1964).

A review of Pu handling hazards is presented in which publications concerned with handling problems are discussed. Recommended practices for safe handling of Pu are reviewed and operating manuals, hazard reviews, and facility designs are discussed. Other discussions are included concerning control of criticality and fire and monitoring of body puncture wounds. (J.R.D.)

43858 FISSION-PRODUCT TRITIUM IN FUEL-PROCESSING WASTE. W. A. Haney. Nucl. Safety, 5: 399-403(1964).

The radiological hazards associated with the disposal of tritium-containing waste are discussed. It is noted that the reductions in tritium concentrations achievable through radioactive decay, dilution, dispersion, and through controlled discharge are the factors to be evaluated in waste-disposal hazard analyses. Discussions of tritium distribution in

waste, tritium movement in soil-water systems, analytical methods, and radiochemical processing plant locations are included. (J.R.D.)

43859 ACCIDENTS IN NUCLEAR ENERGY OPERATION. J. R. Buchanan. Nucl. Safety, 5: 410(1964).

A summary of data on exposures of AEC and AEC-contractor personnel to penetrating radiation during 1962 is presented. A chronological listing of accidents in nuclear energy operations for the period Aug. 8, 1962, to Nov. 30, 1963, is included. (J.R.D.)

43860 NATURAL RADIOACTIVITY IN CZECHOSLOVAK COAL AND METAL ORE MINES. Josef Ševc and Karel Musil. Pracovni Lekar, 16: 312-14(Sept. 1964). (In Czech)

In 1961–1962, an investigation was made of the natural radioactive radiation in eleven coal and five metal ore mines in Czechoslovakia. The radon concentration in the atmosphere of the underground work places, the concentration of short-term daughter products of radon, the concentration of long-term alpha-emitters in the atmosphere, and the intensity of external gamma radiation were determined. At some underground work places the concentration of natural radioactive substances exceeded the highest permitted concentrations for people working with sources of radiation, particularly the concentration of radon and its short-term daughter products the concentration of which can be reduced by common air conditioning devices used for thorough elimination of dust and gases from mines. (auth)

43861 DOSIMETRY OF GAMMA-RAY FROM TELE-COBALT UNIT. Haruma Yoshinaga, Shigetoshi Antoku, and Tadashi Sunayashiki (Hiroshima Univ.). Proc. Res. Inst. Nucl. Med. Biol. (Japan), No. 5, 80-7(1964). (In Japanese)

A cobalt-60 gamma source is being used in radiobiological studies together with the T(d,n) neutron source already established. The basic problem in radiobiological studies using radiation source is to estimate the dose accurately. In the present study, dosimetry was carried out using several dosimeters and the accuracy of dose estimated was reviewed. The average dose rate obtained by seven thimble ionization chambers and ferrous sulfate dosimeters was 59.1 R/min (29 Nov. 63; distance, 70 cm; irradiation field, 16×16 cm^2) and agreed with the value obtained by the ferrous sulfate dosimeter and being employed in biological studies. The reliability of the ferrous sulfate dosimeter was ±6 percent which is the total of the error of G-value, molar extinction coefficient and photospectrometer. A reliability of the same level was suggested from the study of the relative biological effectiveness in mice. Although several values have been reported as the half-life of ^{60}Co, the value of 5.263 years was employed in our studies after a review of literature. Radiation intensity attenuated by the inverse square of distance from the source within the range from 50 cm (13 cm from outlet of vessel) to 175 cm (20 cm from floor). Delivered dose rate at a given distance gradually increased with increase in irradiation field. The difference in dose rate at 70 cm between the maximum field (16×16 cm^2) and the minimum field (2×2 cm^2) was about 10 percent which cannot be ignored in the determination of radiation dose. (auth)

43862 REHABILITATION OF A RADIOACTIVE BUILDING. Henry C. Karp, B. I. Garland, and Nicco Bruin (Fulton County Health Dept., Atlanta). Public Health Rept. (U. S.), 79: 829-35(Sept. 1964).

Procedures used to eliminate the radiation hazard to persons using a building previously used for cancer radiotherapy are described. (H.M.G.)

43863 STUDIES ON THE DECONTAMINATION PROPERTIES OF FABRICS FOR THE RADIOACTIVE CONTAMINATION. PART I. DECONTAMINATION OF URANIUM NITRATE BY USE OF EDTA-2 Na AND SYNTHETIC DETERGENTS. Man Sik Kang and Hack Pil Chung. Rept. Army Res. Testing Lab., 2: 79-82(1963). (In Korean)

Decontamination properties of fabrics for radioactive uranium nitrate contamination were studied using EDTA-2Na and synthetic detergents. Radioactive contamination for cotton fabrics was about nine times as much as that of woolen fabrics. EDTA-2Na was effective for the radioactive uranium decontamination of cotton fabrics and synthetic detergents were ineffective. Optimum decontamination concentration of EDTA-2Na for cotton fabrics was 0.5%. All the decontamination agents used were effective for the radioactive decontamination of woolen fabrics and optimum decontamination concentrations were 0.25% for EDTA-2Na, 1% for both cleaner N and army detergent. First decontamination was sufficient for the radioactive removal at high concentrations of decontamination agents and two decontaminations were necessary at low concentrations. Combination of two decontamination agents used with EDTA-2Na was ineffective for cotton fabrics decontamination. (auth)

43864 STUDIES ON THE DECONTAMINATION PROPERTIES OF FABRICS FOR RADIOACTIVE CONTAMINATIONS. PART 2. DECONTAMINATION OF STRONTIUM-90 BY USE OF EDTA-2 Na AND DETERGENTS. Man Sik Kang, Hack Pil Chung, and Ki Wha Um. Rept. Army Res. Testing Lab., 2: 83-6(1963). (In Korean)

Decontamination properties of fabrics for ^{90}Sr contamination were studied using EDTA-2Na and detergents. Strontium-90 contamination for cotton fabrics was twice as much as that of woolen fabrics. All the decontamination agents tested were effective in radioactive ^{90}Sr decontamination of both cotton and woolen fabrics. Optimum decontamination concentration for ^{90}Sr contaminated cotton fabrics were 0.03% for EDTA-2Na, 2% for cleaner N, and 5% for Army detergent. Optimum decontamination concentration for ^{90}Sr contaminated woolen fabrics were 0.25% for EDTA-2Na and 0.5% for both cleaner N and Army detergent. Decontamination rate of cleaner N decreased at high concentration over 2%. Decontamination rate of cotton fabrics was higher than that of woolen fabrics with successive decontamination. (auth)

43865 FALLOUT IN FOOD AND WATER. Esther K. Sleator and Richard Ferguson. Scientist Citizen, 6: Nos. 9-10, 13-17(Sept.-Oct. 1964).

Factors affecting deposition of fallout, such as time and meteorology, and entrance of fission products into the food chain are discussed. Strontium-90 levels in samples taken in 18 US cities in 1963 and 1964 are compared, and the present status of fallout in food is summarized in tables and graphs. Factors determining radioactivity levels in water that are considered include: geography, topography, precipitation, and storage. Effects of the Nuclear Test Ban Treaty on food and water radioactivity levels are implied. (H.M.G.)

43866 DETERMINATION OF EFFICIENCY OF FILTERS WITH RADIOACTIVE AEROSOLS OF KNOWN SIZE. Jean Bricard (Institut d'Optique, Paris), F. Billard, Guy Madelaine, and Jaques Pradel. Staub, 24: 345-8(Sept. 1964). (In German)

It is proposed to investigate the efficiency of filters by using specially labeled, natural aerosols and to replace the granulometric method (determination of concentration and particle size before and after the filter) by measure-

ments of the α activity. Labeling of the natural aerosols is carried out by accumulation of ThB atoms, whose half life is sufficiently long for determination of the activity. Since the electrical charge on the particles so labeled does not exceed a few elementary charges it is assumed that the particles will behave as neutral particles in filtration. (auth)

43867 REGLEMENTATION RELATIVE AUX RADIOELEMENTS ARTIFICELS (EXTRAITS SELECTIONNES). (Statutory Provisions Relating to Artificial Radioelements (Selected Extracts)). 2nd Edition. Gif-sur-Yvette, France, Commission Interministerielle des Radioelements Artificiels, 1963. 24p.

Topics included are: the special statutory provisions relating to artificial radioelements which are in force in France, as contained in the Public Health Code, and the specific conditions under which artificial radioelements approved by the French Interministerial Committee on Artificial Radioelements may be employed; and the general French statutory provisions on radioactive substances, governing artificial radioelements (safeguarding of public health, environmental protection, protection of workers, transport of artificial radioelements). (Occupational Safety Health Abstr., 2: No. 7, 1964)

43868 CONTROL OF HAZARDS IN NUCLEAR REACTORS. T. C. Sinclair. London, Temple Press, 1963. 84p. 15s.

This volume, one of a series of nuclear engineering monographs, deals with the safety aspects of nuclear reactor operation, including the biological hazard (acute, subacute and genetic effects of radiation, maximum admissible levels in air, water and body, surface contamination); the effects of radiation on reactor materials (creep and corrosion resistance, types of radiation damage, annealing and hardening, increased tensile strength of steel); fuel and canning (thermal cycling, fuel element failure, fuel element measurement, etc.); the pressure circuit (design and operational limitations of pressure vessel and design stress values); and reactor safety and siting (solid wastes, liquid and gaseous effluents, monitoring programs and maximum admissible levels under accident conditions), safety being defined as a reduction of hazards until an acceptable calculated risk has been achieved. (Occupational Safety Health Abstr., 2: No. 8, 1964)

43869 MANUAL OF INDUSTRIAL RADIATION PROTECTION. PART III. GENERAL GUIDE ON PROTECTION AGAINST IONIZING RADIATIONS. Geneva, International Labour Office, 1963. 95p. 5Sw.Fr., US $1.25; 8s. 9d.

This guide is designed principally to assist the radiation worker, the engineer, the industrial administrator and all those who are not radiation safety specialists in acquiring an understanding of the facts and philosophy of modern radiation protection. Individual chapters are devoted to the following topics: fundamentals of physics; dose units and limits; radiation measuring instruments; principles of radiation protection (external radiation protection, personal contamination control, waste disposal); surveillance (environmental and personal monitoring, bioassay, medical supervision). The test is illustrated by numerous tables and figures. Parts I and II of this manual, published in 1963 and 1959, respectively, are dealt with on CIS 1098-1963, Boz(02) and CIS 332-1960, Boz(02). (Occupational Safety Health Abstr., 2: No. 8, 1964)

43870 COURS SUR LA PROTECTION CONTRE LES RADIATIONS IONISANTES DANS L'INDUSTRIE. VOLUMES I, II, AND III. (Course on Radiation Protection in Industry. Volumes I, II, and III). D.23/1963. Geneva, International Labour Organisation, 1963. 552p.

A course on Radiation Protection in Industry was held at the French National Institute of Nuclear Science and Technology, Saclay, 1960. Approximately 50 lectures were given and are presented in 3 volumes published in French. Volume I deals with fundamentals of nuclear physics, radiation measurement, radiation sources, the mining and preparation of radioactive ores, and industrial use of ionizing radiations. Volume II deals with radiobiology, radiation hazards, detection of external exposure and personal contamination, safety regulations, and shielding. Volume III deals with the organization of radiation protection, transport of radioactive substances, the treatment of persons suffering from radiation injury or contamination, and the activities of the international organizations in the field of radiation protection. (C.H.)

43871 FARMING PRACTICES AND CONCENTRATIONS OF FISSION PRODUCTS IN MILK. Warren G. Hansen, Jeptha E. Campbell, Jack H. Fooks, H. Clifford Mitchell, and C. Howe Eller (Saint Louis County, Mo. Health Dept. and Public Health Service, Washington, D. C.). Environmental Health Series, Radiological Health. Public Health Service Publication No. 999-R-6. May 1964. 48p. Free (Public Health Service, Washington, D. C.).

Studies conducted over a 3-year period have shown that levels of strontium-90 and iodine-131 in milk can be moderated by optimal fertilization of the land. In controlled experiments, milk from cows grazing on abundant, well-fertilized pastures contained 50 percent or less of these radionuclides than did milk from cows grazing on unfertilized pastures on the same farm. A mechanism of dilution of the fission-product contamination in the larger volume of faster growing fertilized forage was shown to account for the differences in the milk. The findings suggest one possible means of controlling fission-product contamination in milk, if such control measures should be necessary. The results indicate that the high levels of strontium-90 in the St. Louis raw milk sample may have been due more to marginal fertilization of the farms in that sample than to uneven deposition of fallout. (auth)

43872 PRESENT-DAY GAS MASKS WHICH ARE WELL ADAPTED TO INDIVIDUAL PROTECTION AGAINST RADIOACTIVE CONTAMINATIONS. F. Billard and J. M. Lavie. 15p. (CONF-337-10). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The effectiveness of present-day gas masks to provide individual protection against radioactive contaminants was studied by comparing the risks from external irradiation and from internal irradiation for an individual wearing a French gas mask. The irradiation risks encountered in a reactor incident and a nuclear explosion are the two cases considered. Examination of the values of the ratio of the external dose to the internal dose showed that the individual wearing a gas mask runs much greater risk of external exposure than internal exposure. This conclusion is much sharper in the case of a nuclear explosion. In the case of a reactor incident, under the most unfavorable conditions, the filtering devices installed on the reactor container were not taken into account. It was concluded that an improvement of the filtration efficiency of gas masks would not significantly improve individual protection. (J.S.R.)

43873 CONTAMINATION OF MILK FOLLOWING AN ACCIDENTAL ATMOSPHERIC RELEASE OF IODINE-131.

R. J. Kirchmann and R. R. Boulenger. 15p. (CONF-337-9). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

Two series of experiments were carried out in 1962 and 1963 in order to determine the results of an accidental contamination of herbage on the ^{131}I concentration in milk. The effects of the height and nature of the herbage, season in which contamination occurred, and the meteorological conditions (particularly rain) on the extent of the milk contamination were determined. The fields were sprayed with radioiodine in CH_3CH_2OH solution. The direct retention of ^{131}I by the grass and its uptake by cattle and contamination of milk were measured. The results were tabulated and showed great variation in the percentage of ^{131}I directly retained by the grass. The evolution of the specific activity of the herbage did not appear to be affected by the presence of cattle nor by atmospheric precipitations. The secretion of ^{131}I in milk was slightly less than that found previously. The maximum value in 1962 was 0.0056 μc $^{131}I/l$ for a deposit of 0.1 $\mu c/m^2$ and in 1963, 0.024 μc for a deposit of 0.62 $\mu c/m^2$. (J.S.R.)

43874 UTILIZATION OF FUMIGENES FOR VENTILATION STUDIES. (EVALUATION OF RECYCLINGS; MEASUREMENT OF TRANSIT TIMES). F. Billard, J. Brion, J. Miribel, and J. Pradel. 18p. (CONF-337-52)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

A quantitative method for the study in real magnitudes of the exterior cycling of the ventilation of a building was perfected using fumigenes. The principle of the method is based on the use of an aerosol photometer that measures the relative concentration of atmospheric particles. An aerosol emission is provoked in the air extraction circuit. By comparison of the aerosol concentration at the air release and uptake levels, the cycling rate is determined. The procedure and the sensitivity are reported. The transit times in the air extraction circuit are determined in the same manner. Examples are given of both types of measurements. (J.S.R.)

43875 CONTROL OF IODINE-131 IN IRRADIATED FUEL PROCESSING PLANTS. R. Estournel and F. Gallissian. 19p. (CONF-337-54)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

During the processing of irradiated fuel elements, the fission products can be released to the atmosphere in the form of gases or powders. At Marcoule these gaseous fission products are mixed with air and released into the atmosphere by an 80-m chimney after filtration. The origin and conditions for the release of ^{131}I at Marcoule are reviewed. The filtration efficiency of the radioiodine and the characteristics of the different outlet filters were determined. The results of the monitoring of the gases showed that the processing of irradiated uranium after a sufficiently long storage causes only a very low emission of ^{131}I. (J.S.R.)

43876 TRITIUM AND TRITIATED WATER: TIME LIMITS OF ACCIDENTAL EXPOSURE IN STABLE OR REGENERATED ATMOSPHERES. A. Gey. 57p. (CONF-337-46)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

Accidental contamination due to tritium is treated as usual as originating from tritiated water vapor. This estimation is pessimistic if it is considered that tritium gas does not diffuse in the organism across epithelial tissue, slightly across pulmonary tissue, and is oxidized only slowly in the absence of external catalysts. In choosing among the perhaps contradictory data those that lead to an optimistic outlook of the dangers actually encountered, the curves are defined beyond which the norms are exceeded. The actual risk is found then between these curves and those from the pessimistic hypothesis of an absorption of completely oxidized tritium in the form of tritiated water. The graphic representation of these curves in logarithmic coordinates makes possible, by the use of approximate formulas, the verification of the doubtful or contestable parameters by simple translation of the curves (or sections of the curves) parallel to themselves. Its use is then not bound strictly to chosen numerical values if the analytical expressions of the laws for self-oxidation and the organic absorption of tritium are not radically introduced. Under these conditions, the curves maintain a certain character of universality. (tr-auth)

43877 STUDY OF THE MOBILITY AND OF THE FILTRATION OF ULTRA-FINE AEROSOLS. Jacques Fontan, Daniel Blanc, Andre Bouville, and Manuel Juan (Centre de Physique Nucleaire, Toulouse, France). 14p. (CONF-337-49)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

Ultrafine aerosols are produced in the airtight volume of the decay chamber of the measurement device used assuring the continuous measurement of the natural radioactivity of the atmosphere. In effect, the air that enters the decay chamber is cleaned of all atmospheric aerosols by filtration across a series of paper filters. The natural radioactive gases decay in this filtered atmosphere and give descendents that constitute the ultrafine aerosols. The mobility of these aerosols and their filtration with some commercial filters were studied. The stopping power of the filters was clearly superior for ultrafine aerosols than for atmospheric aerosols. (tr-auth)

43878 VARIATION OF THE EFFICIENCY OF FILTERS AS A FUNCTION OF THEIR WARPING. F. Billard, G. Madelaine, and J. Pradel. 21p. (CONF-337-48)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The warping of filters by atmospheric dusts is very slow. Therefore a method was studied that made possible a rapid warping of the different filters used by the C.E.A. The knowledge of this variation curve as a function of time and of the dust mass yielded data on the behavior of filters. The evolution of the filters was also followed as a function of their warping by different aerosols. The efficiency of different filter papers for various types of aerosols was determined with the use of a spectrophotometer for particles with diameter greater than 0.3 μ. The filters were warped with these aerosols and the variations of the efficiency were determined with a standard aerosol. The results showed that for a solid or a non-oily aerosol the efficiency increased with warping. The phenomenon was reversed for an oily aerosol and the permeability increased with the warping. (J.S.R.)

43879 ROLE OF INLET FILTERS IN HIGH-ACTIVITY LABORATORIES. (INFLUENCE OF THE VENTILATION CHARACTERISTICS OF A ROOM ON THE NATURAL α RADIOACTIVITY LEVEL OF AN AIR-SAMPLING FILTER). F. Billard, J. Brion, and J. Pradel. 17p. (CONF-337-53)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The quantity of natural radioactivity collected on a dust sampling filter, placed at the interior of a hot laboratory provided with inlet filtration, was defined as a function of the efficiency of the inlet filter and of the frequency of the air renewal in the laboratory. The relation between the ventilation characteristics of the laboratory and the reduction of the background of the sampling filter was derived. The formulas derived were confirmed experimentally. (J.S.R.)

INSTRUMENTATION

General

Refer also to abstracts 43777, 44771, and 44936.

43880 (AWRE-O-54/64) THE CONSTRUCTION AND OPERATION OF A HELIUM DENSITOMETER. J. H. Sant (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Aug. 1964. 27p.

An apparatus is described which was constructed for the accurate determination of densities of finely ground powders by helium displacement. A number of practical difficulties were encountered, and these are reported together with the modifications to the original design by which they were overcome. (auth)

43881 (BMI-X-310) EXPERIMENTAL TECHNIQUES USED FOR HIGH-TEMPERATURE, VACUUM IRRADIATIONS OF ELECTRICAL COMPONENTS AND MATERIALS. Sam J. Basham, W. G. Rieder, J. H. Stang, H. T. Gruber, and B. P. Fairand (Battelle Memorial Inst., Columbus, Ohio). Oct. 10, 1964. Contract W-7405-eng-92. 47p.

A group of materials and electrical components was exposed to an integrated fast-neutron exposure of about 1×10^{19} n/cm^2 while in an environment of high vacuum ($<10^{-5}$ torr) and high temperature (600 to 1100°F) to obtain radiation-effects data for the Atomics International SNAP program. Four separate experiments were conducted; 34 specimens were exposed in the first, 6 specimens in the second, 48 specimens in the third, and 32 specimens in the fourth. Detailed measurements of the nuclear environment were made to aid in the study of radiation damage of the specimens. Significant specimen parameters of the electrical components were measured during the irradiation. These data were transmitted to Atomics International for use in SNAP program systems development. (auth)

43882 (IAE-603) OBLASTI PRIMENENIYA I OSNOVNYE REZHIMY RABOTY REGISTRATOROV CHETVERTOGO TIPA (OBZOR). (Fields of Application and Fundamental Operating Modes of the Fourth-Type Recorders (Survey)). G. P. Mel'nikov (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 26p.

Fourth-type recorders, first used with ELA-type analyzers, are based on the successive treatment of memory cells. Due to summing operations, which are typical for single-channel analyzers, the successive operations do not increase the time loss. Descriptions are given of various applications of the recorders: channel summing and subtracting, time selection with channel width larger, smaller, or equal to the time of one memory element, multidimensional measurements, operations with several transducers, and measurements of Mössbauer spectra. (R.V.J.)

43883 (IAE-616) TRANZISTORNYI REVERSIVNYI DESYATICHNYI SCHETCHIK IMPUL'SOV. (Transistorized Reversing Decade Pulse Counter). G. R. Gol'bik and V. D. Shestakov (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 6p.

Descriptions are given of a reversing decade counter of the consecutive parallel type with constant consecutive connection between counter triggers. The transition to decimal regime is accomplished by a parallel supply from the ninth pulse at the second and third decade trigger. (tr-auth)

43884 (IAE-617) SPEKTR SOBSTVENNYKH SHUMOV I DISPERSIYA KOEFFITSIENTA USILENIYA MNOGOKASKADNYKH ELEKTRONNO-OPTICHESKIKH PREOBRAZOVATELEI. (Spectrum of Characteristic Noises and Enhancement of the Dispersion Coefficient in Multi-Stage Electron-Optical Converters). B. A. Demidov, G. E. Smolkin, V. M. Sotnikov, G. N. Sofiev, and S. D. Fanchenko (U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 16p.

The noise spectrum and dispersion coefficients of 95 electron-optical converters were analyzed using a multichannel analyzer. The method used in eliminating edge effect is described. The dispersion coefficients were found to have a Poisson distribution. (tr-auth)

43885 (IDO-16999) DYNAMIC PRESSURE MEASUREMENT DEVICES IN NUCLEAR REACTORS. P. H. Hofhine (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Aug. 1964. Contract AT(10-1)-205. 80p.

The main requisites to be met by a pressure sensor intended for making dynamic pressure measurements in a nuclear reactor conducting transient studies are described. These requisites pertain to frequency, acceleration, temperature, and radiation responses of the sensor. Techniques developed for determining the frequency and acceleration response of a given sensor are described. The most used test method utilizes exploding wire techniques to generate pressures of an impulse nature. The other important test technique utilizes chemical explosives to generate longer duration, larger magnitude pressures. (auth)

43886 (IFA-M-33) OSCILLOSCOPE FOR BETATRON MONITORING. I. Leibovici (Academia R. P. R. Institutul de Fizică Atomică, Bucharest). 1964. 13p.

For monitoring the proper work of betatron circuitry, a CRT–oscilloscope is necessary, whose characteristics are in some respects different from those of standard oscilloscopes available on the market. For the I.A.P.–betatron, a specialized double-beam oscilloscope was built. Its principal features are: (a) The existence of two time-bases, the first of which is an elliptical one and the second a linear one. The first time-base has a horizontal deflection proportional with the betatron magnetic field, and is used as a general display. The second triggered time-base plays the part of an "electronic magnifier," for the detailed display of the waveforms. (b) The triggered time-base can be synchronized externally, internally, or at every moment of the acceleration cycle. (c) The moment of the beginning of the "electronic magnifier" is marked on the general display by a brighter spot. A block-diagram of the scope circuits and detailed diagrams of the principal parts are given. (auth)

43887 (IFA-M-37) IMAGE QUALITY IN BETATRON RADIOGRAPHY. I. Leibovici (Academia R.P.R. Institutul de Fizica Atomica, Bucharest). 1964. 17p.

The problem of defining and estimating the quality of a radiographic image and the main factors the quality depends upon, namely contrast and definition, are analyzed, based on the working experience accumulated with the I.A.P.–

betatron and taking into account the opinions previously published on the subject. Experimental results are given about the effect on image quality of such factors as: radiographic film type, photographic density, development time, etc. Some precautions relating to focal spot size reduction, intensifying screen manufacturing, stray radiation reduction, film viewing illuminators, are also indicated. (auth)

43888 (LA-3119) NET-1 NETWORK ANALYSIS PROGRAM: 7090/94 VERSION. Allan F. Malmberg, Fred L. Cornwell, and Florian N. Hofer (Los Alamos Scientific Lab., N. Mex.). Aug. 10, 1964. Contract W-7405-eng-36. 110p.

NET simulates the d-c steady-state behavior and the transient behavior of a large class of electrical circuits that may contain passive and solid-state components; including junction transistors and junction diodes, signal sources and fixed voltage sources, and fixed-value resistors, capacitors, inductors, and mutual inductive coupling. NET-1 is restricted to use where junction transistors and diodes are the active elements; an internal library of transistor and diode parameters is included. The program was translated from MANIAC II language for use on IBM 7090 or 7094. (R.E.U.)

43889 (NLCO-920(p.19-24)) DESIGN AND OPERATION OF A VACUUM DIFFERENTIAL THERMAL ANALYZER. W. A. Althaus, M. M. Cook, and D. Spadafora (National Lead Co. of Ohio, Cincinnati).

A differential thermal analysis (DTA) instrument was designed and built to determine accurately the solid-state transformation temperatures of uranium and uranium alloys. Data are presented on the transformation temperatures of a uranium sample containing 220 ppm silicon. (auth)

43890 (NAA-SR-Memo-10084) DEVELOPMENTAL TEST OF SNAP 10A RESISTANCE THERMOMETERS IN A COPPER BLOCK ATTACHMENT CONFIGURATION. A. P. Hamilton (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 15, 1964. Contract AT(11-1)-Gen-8. 47p.

Three SNAP-10A resistance temperature detectors were tested to investigate the feasibility of attaching the sensor to the NaK tube via a prototype copper block clamping configuration. The tests demonstrated the accuracy of the detectors at 10^{-3} Torr and 1000°F. The results showed a maximum error of 35°F; this error could be reduced by raising the vacuum chamber temperature or by using Siflake 850 between the detector and the block in addition to the goldmoly foil installation. (D.L.C.)

43891 (ORNL-P-482) ANALYTICAL ELECTRON MICROSCOPY PAST AND PRESENT AT OAK RIDGE NATIONAL LABORATORY. T. E. Willmarth (Oak Ridge National Lab., Tenn.). [nd]. Contract [W-7405-eng-26]. 8p. (CONF-730-1)

From Electron Microscopy Society Conference, New Orleans, Oct. 1964.

A general description is given of the electron microscopic activities of the Analytical Chemistry Division. Some historical highlights are given, and the instruments and other equipment are described. Typical problems which are encountered are given; they involve bacteria in scum from the bulk shielding reactor, sampling of fission product aerosols, structure of thoria sol gel beads, etc. (D.L.C.)

43892 (SC-R-64-178) A RADIATION-HARDENED TELEMETRY SYSTEM. V. K. Smith and D. L. Trapp (Sandia Corp., Albuquerque, N. Mex.). June 1964. Contract AT(29-1)-789. 9p. (CONF-736-1)

From National Telemetering Conference, Los Angeles, June 1964.

A description is given of a solid-state FM/FM telemetry system which will survive and operate within specifications through a pulsed radiation environment of 10^{14} neutrons per square centimeter (nvt) with energies greater than 10 kev. The system will recover from an associated gamma pulse of approximately 10^{12} roentgens per second in less than 5 milliseconds, and operate within specifications through a 125-g, 3 millisecond shock pulse. The method of development is described and test results are given. (auth)

43893 (TID-7697(p.2.11.1-7)) DIRECT MEASUREMENT OF FREE FISSION GAS PRESSURE IN OPERATING FUEL RODS. M. B. Reynolds (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.).

The Booth-Cromer pressure transducer was adapted for measuring fission gas pressure in fuel rods at high temperatures in a fast neutron field. The readout instrumentation used with the transducer is described. The transducer was used with fuel rods with thicker-than-normal cladding in the Vallecitos Boiling Water Reactor core. (D.L.C.)

43894 (TID-7697(p.4.2.1-14)) CAPSULE INSTRUMENTATION AT AERE. I. H. McWilliam and C. B. T. Braunton (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

Development of instrumentation at AERE has been guided by the three requirements of accuracy, reliability, and simplicity. This has resulted in the development of a control system which has been found to be adequate for the vast majority of irradiation experiments, special instruments being required only on rare occasions. An outline is presented of this system and its further development; some of the minor instrumentation required to perform certain specialized and unusual functions are also described. (auth)

43895 (TID-7697(p.4.3.1-10)) DEVELOPMENT PROGRAM TO INCREASE THERMOCOUPLE RELIABILITY FOR IN-PILE EXPERIMENTS. Everett L. Babbe (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.).

An investigation is being conducted of the causes of failure of metallic sheathed, MgO-insulated thermocouples after thermal cycling. The effects of insulation pack density and various wire-sheath combinations were studied. Results to date indicate that failures are due to differential expansion of the sheath, with Inconel giving a lower failure rate than stainless steel, and to insulation pack density, with the higher densities giving lower failure rates. (D.L.C.)

43896 (TID-7697(p.4.4.1-9)) LABORATORY STUDIES TOWARD IMPROVEMENT OF HIGH-TEMPERATURE THERMOCOUPLES. J. F. Lagedrost (Battelle Memorial Inst., Columbus, Ohio).

Studies were made of the effects of thermal cycling between 1000 and 2000°F on Chromel–Alumel units and between 1000 and 2800°F on tungsten–rhenium units. The results for Chromel–Alumel indicated that almost all failures occurred in the Alumel leg and that maximum life was obtained with use of "moderate-packed" MgO insulation and Inconel sheath. The results for Nb–1 Zr-sheathed

MgO-insulated W–5 Re/W–26 Re units indicated longer life for these units with ungrounded junctions. (D.L.C.)

43897 (TID-7697(p.4.5.1-6)) AUTOMATIC REDUCTION OF LONG-TERM IRRADIATION CAPSULE THERMOCOUPLE DATA. C. T. Walters and E. O. Fromm (Battelle Memorial Inst., Columbus, Ohio).

A description is given of the methods and system used for reducing thermocouple temperature data from long-term irradiation experiments on homogeneous fuels in ETR. The data in the form of punched paper tape are converted to punched cards for analysis on a digital computer. The final form of the data is a weekly summary sheet. (D.L.C.)

43898 (Y-KG-24) SPARK-SOURCE MASS SPECTROGRAPH. J. C. Franklin and W. D. Harman (Union Carbide Corp. Nuclear Div. Y-12 Plant, Oak Ridge, Tenn.). Oct. 1, 1964. Contract W-7405-eng-26. 8p. (CONF-721-3)

From 8th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Tenn., Oct. 1964.

A brief description is given of the mass spectrograph at the Y-12 Plant, a MS-7 double-focusing instrument with Mattauch-Herzog geometry. Comparative analyses are given of Zr, Cu, stainless steels, Pt, and U. (D.L.C.)

43899 (ANL-Trans-77) RO AND ZEBRA. THE MEASUREMENT OF DEAD TIME IN PULSE ELECTRONICS. C. E. Wikdahl (Aktiebolaget Atomenergi, Stockholm). Translated for Argonne National Lab., Ill., from report TPM-RFX-108. Mar. 17, 1961. 5p.

The measurement of the dead-time of electronic systems using two detectors and three amplification channels with a mixer is discussed. It is shown that mixer amplification does not have to be one for precision measurements. (R.E.U.)

43900 (SLAC-Trans-10) MEASUREMENT OF HIGH-FREQUENCY FIELDS IN RESONATORS. S. P. Kapitsa and Yu. M. Tsipenuk. Translated for Stanford Univ., Calif., from p.133-47 of "Elektronika Bol'Shikhmoshchnostei" (a publication of the Publishing House of the Academy of Sciences, USSR, Moscow, 1963). 22p.

The method of measurement of the distribution of electromagnetic fields in resonators and of their shunt resistance, with the aid of disturbing balls that transit freely through the resonator, is described. The cavity resonator is used as a frequency discriminator in which the disturbance of the natural frequency causes the variation in the amplitude of the field. The corresponding signal is detected, transmitted to the oscilloscope, and photographed. The results of the survey of microtron resonators are presented. It is found experimentally that the accuracy of determination of the shunt resistance and of the field distribution is about 8%. (auth)

43901 EFFECTS OF SPACE RADIATION ON TRANSISTORS. Leonard B. Gardner (Consulting Scientists, North Hollywood, Calif.) and James R. Coss. Am. Soc. Testing Mater., Spec. Tech. Publ., 363(1963), 90-6(1964).

The effects of electrons and protons on transistors are discussed, with consideration of damage mechanisms, space radiation, and experimental observations. It is concluded that present thin-base Ge devices could operate up to one year in a space probe, while thin-base transistors operating in the center of the inner Van Allen belt would have a useful life of about three days. (D.C.W.)

43902 BINARY-QUINARY LOGIC IMPROVES DECADE COUNTERS. K. D. Smith (Phillips Petroleum Co., Idaho Falls, Idaho). Electron. Design, 4p.(July 6, 1964).

The development of decade counters using binary-quinary logic is discussed. Counter logic, which eliminates feedback, has a minimum of readout components and a symmetrical code. The decade counter code system is illustrated, and a mathematical analysis of the quinary circuit is presented. (C.E.S.)

43903 TRADING OFF RADIATION RESISTANCE AND SECOND-BREAKDOWN PERFORMANCE. Bernard Reich and Edward B. Hakim (Army Electronics Lab., Fort Monmouth, N. J.). Electronics, 37: No. 27: 48-51(Oct. 19, 1964).

The reaction of transistors to both radiation and second breakdown is described, and a compromise between breakdown performance and radiation resistance is suggested. (D.C.W.)

43904 INTERPHASE POSITION AND OSCILLATION MEASUREMENT IN PULSED COLUMNS. G. Bodini, A. Facchini, A. Novelli, and A. Rimini (CESNEF, Milan). Energia Nucl. (Milan), 11: 445-6(Aug. 1964).

An apparatus that enables the continuous measurement of the interphase position and consequently the control of flow of liquids in a pulsed column is described. The operating principle of the apparatus is based on the measurement, between two electrodes, of the electrical resistance variations in alternating current, caused in the upper column expansion, by the oscillations of the interphase surface of the two liquids that constitute the extraction biphasic system. (P.C.H.)

43905 A DEUTERIUM-FILLED 200-MW-THYRATRON OF LATEST DESIGN. L. E. Algar (General Electric Co., Ltd., [Erith, Kent, Eng.]), J. E. Marshall, and C. R. Russell. Intern. Elektron. Rundschau, 17: 573-6(Nov. 1963). (In German)

The deuterium-filled thyratron GHT6 is a high output tube for radar and nuclear physics research instruments, which has a water-cooled metal casing, a peak capacity of 200 Mw, and a rating of 150 kw. The metal construction makes possible easy cooling of all electrodes and a very high output at relatively small sheath. Grid emission and gas pressure variations were eliminated by electrode heating. The greater breakdown voltage of deuterium in comparison with hydrogen makes possible an anode voltage on 40 kv on only one grid. (tr-auth)

43906 THE CONTROL AND PRINTOUT PROGRAMMING SYSTEMS OF THE FH49A, FH49B, FH90A, FH91C STANDARD INSTRUMENTS AND ALSO FH COMBINATION PROGRAM INSTRUMENTS. K. Goerlach. Mitteilungsbl. Strahlungsmessgeraete, 5: No. 11, 3-5(Feb. 1964). (In German)

A control or printout programming system is used for the automatic control of measuring process and for the recording of the digital values of time or number printers. The control of radiation measurement devices of the FH combination program and of the standard instruments FH49A, FH49B, FH90A, FH91C is subordinated to these systems. A review is given of the operation of both the control and printout systems. (J.S.R.)

43907 THE USE OF A MAGNETIC SPECTROMETER AS A SPECTROGRAPH. J. A. Cookson and J. L. Wankling (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 30: 88-100(Nov. 1964).

A 180° double-focusing, heavy-particle spectrometer with a radius of 61 cm was modified for use as a spectrograph. For a region of the focal plane covering approximately 10% of the mean energy, the solid angle is 0.007 steradians, and the energy resolution is better than one part in 1100. (auth)

43908 AN IMPROVED DECIMAL SCALING CIRCUIT. E. H. Cooke-Yarborough, E. A. Sayle, and J. P. Kerry (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Instr. Methods, 30: 106-8(Nov. 1964). (AERE-M-1347)

A decimal scaling circuit consisting of two two-state circuits and one three-state circuit is described, requiring seven transistors in all. The sequencing of these circuits to make a scale-of-ten is simple and avoids the timing tolerance difficulties encountered in some other forms of decade. All the transistors operate saturated with their emitters grounded, enabling the decade to deliver well-defined binary-coded decimal output voltages directly to external circuits. (auth)

43909 THE NATURAL LIMIT OF SHORT TIME MEASUREMENT WITH DELAY COINCIDENCE. W. Brunner (Karl-Marx Universität, Leipzig). Nucl. Instr. Methods, 30: 109-15(Nov. 1964). (In German)

With a fast differential coincidence system the limit of short-time-measurements, given by noise in the differential coincidence circuit and the following electronic circuitry, was determined. The resolving time as a function of the magnitude of the input pulses for tube diodes and semiconductor diodes, was measured, as well as the temperature dependence for semiconductor diodes. The shortest resolving time was 0.5 psec. (auth)

43910 THE OPTIMAL CONDITIONS FOR THE OPERATION OF A HIGH-FREQUENCY ELECTRICALLY EXCITED SOURCE OF POSITIVE IONS AND INDUCTIVE COUPLING IN THE PRESENCE OF A CONSTANT AUXILIARY MAGNETIC FIELD. G. Krammer, P. Benoit-Cattin, A. Degeilh, J. Bacri, and D. Blanc (Faculté des Sciences, Toulouse). Nucl. Instr. Methods, 30: 123-4 (Nov. 1964). (In French)

The variation of the ionic current as a function of the intensity of an auxiliary magnetic field H was measured in three possible relative orientations of the exciting r-f coil and H. In all three cases, an optimum value of H was identified; but the best results were obtained with an axial magnetic field and a transverse coil. (D.C.W.)

43911 A DEVICE FOR ABSOLUTE VELOCITY MEASUREMENT OF R. F. MODULATED BEAMS. D. C. Hagerman and M. Jakobson (Los Alamos Scientific Lab., N. Mex.). Nucl. Instr. Methods, 30: 154-6(Nov. 1964). (LADC-6441)

A method for measuring the velocity of r-f modulated charged particle beams is described, which can provide accuracies of the order of 0.1%. Sources of error and limitations of the method are discussed. (auth)

43912 THEORETICAL STUDY FOR A NUMERICAL TRANSFER FUNCTION ANALYZER. J. Freycenon (Centre d'Etudes Nucleaires, Saclay, France). Onde Elec., 44: 774-80(July-Aug. 1964). (In French)

The harmonic analysis of the sampling of a signal represented by the instantaneous value of the counting rate of a pulse sequence was studied. The sampling, with integration imposed by a signal of this type, led to a modification of the Nyquist formulas on spectrum crossover. The study of the random errors owing to the statistical fluctuations of the signal showed that this analysis procedure was equivalent to a filter rejecting the high frequency components with an equivalent pass band equal to the inverse of the measurement time. A simple procedure that yields results close to those of Fourier analysis is proposed. (tr-auth)

43913 A DESIGN OF A FERRITE DEVICE FOR HIGH-VOLTAGE NANOSECOND PULSES. R. B. Baksht and G. A. Mesyats (Tomsk Polytechnic Inst., USSR). Pribory i Tekhn. Eksperim., No. 3, 108-10(May-June 1964). (In Russian)

A device is described for obtaining short pulses with amplitudes to 20 kv using a ferrite-torus nonlinear element enclosed in a cable, by which the voltage pulse is propagated. Data are presented for the effect of the parameters of the propagated pulse on the shape and amplitude of the output signal. (tr-auth)

43914 A STANDARD CALIBRATING SOURCE FOR ULTRA HIGH FREQUENCY POLARIMETERS. A. M. Karachun and A. E. Salomonovich (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 3, 119-20(May-June 1964). (In Russian)

Unless polarimeter channels are frequently calibrated, the size of the radiometer parasitic signals must be measured. A basic problem is presented by parasitic signals proportional to the full intensity, which for weakly polarized radiation sources is near the intensity of the nonpolarized component. Thus a standard calibration source, parallel with the polarized radiation, must give nonpolarized radiation of sufficiently high intensity. Often a heated symmetrical coordinated load in a round wave guide is used for uhf-polarimeter calibration; this is not very suitable for the desired purpose, since the temperature of such a standard may reach 400 to 500°K, which does not ensure the necessary measurement accuracy. (tr-auth)

43915 THE INITIAL CALIBRATION OF DECIMETRIC RANGE NOISE EMISSION. Yu. S. Rusinov and R. L. Sorochenko (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 3, 121-2(May-June 1964). (In Russian)

Exact measurement of noise temperature is important for radioastronomical and cosmic-ray applications. For systematic measurements, noise diodes are used with meter waves, and gas-discharge tubes for the uhf range. In the decimeter range, these types of apparatus may in principle be used; however, measurement error may be significant. Resonance phenomena begin to have a strong influence on the radiation power of the noise diode in the decimeter range, and the electron time of flight is no longer negligibly small. These factors are difficult to take into consideration. The effects depend strongly on technological tolerances, and thus they can vary strongly for different devices of the same type. The noise temperature of gas-discharge tubes also cannot be determined with sufficient accuracy by this means, and the divergence between different examples may reach 10%. (tr-auth)

43916 AUTOMATIC IONIZATION CURVE RECORDING. V. K. Potapov, A. G. Arsent'ev, V. E. Kazakevich, A. K. Piskunov, and N. N. Chizhevskaya (Scientific Research Inst. of Physics and Chemistry, USSR). Pribory i Tekhn. Eksperim., No. 3, 123-5(May-June 1964). (In Russian)

A device for automatic ionization-curve recording on a mass spectrometer is described. The use of ion-current resonance amplification, corresponding ionization by electrons with a given energy spread, and synchronous detection and recording of ionization curves independently on the recorder permits an increase in the rate of reading the ionization curves as well as in the sensitivity and accuracy of the mass spectrometer for measuring potentials, in comparison with the known hand method of electron "quasi-monokinetization." (tr-auth)

43917 COINCIDENCE METHOD IN THE INVESTIGATION OF PHOTO-ELECTRON MULTIPLIER SINGLE-ELECTRON MOMENTUM STATISTICS. A. N. Pertsev, A. N. Pisarevskii, and L. D. Soshin (Belorussian State Univ., USSR). Pribory i Tekhn. Eksperim., No. 3, 132-5 (May-June 1964). (In Russian)

A method is described for studying the amplitude distribution of momenta in a photomultiplier, corresponding to the emission of single electrons from the photocathode, using a coincidence scheme. It is shown that the amplitude distributions of single electron momenta obtained by this method obey the Poisson law. (tr-auth)

43918 DEVICE FOR MEASURING RELATIVE SCINTILLATOR LUMINESCENCE. G. A. Kibal'chich and Yu. P. Belogurov (All Union Scientific Research Inst. of Monocrystals, USSR). Pribory i Tekhn. Eksperim., No. 3, 139-42(May-June 1964). (In Russian)

A method is described for measuring the average scintillation-pulse amplitude, which characterizes the relative scintillator light emission. The method enables a relative estimation of light emission to be carried out, independent of the type, shape, and dimensions of the scintillators, and also of the position and activity of a gamma-excitation source. On the basis of this method, a device was set up with direct reading of the measured values. The relative luminescence of various organic scintillators was measured. (tr-auth)

43919 A SMALL-BEAM DEVICE FOR STUDYING X-RAY SCATTERING AT SMALL ANGLES. A. E. Gromov and A. I. Slutsker ([Leningrad Inst. of Physics and Tech.]). Pribory i Tekhn. Eksperim., No. 3, 165-7(May-June 1964). (In Russian)

An apparatus is described in which a collapsible fine-focused x-ray tube serves as source and a narrow beam is collimated in a small-angle x-ray chamber. The angular spread of the chamber is 7'. In constructing the tube and chamber, a series of changes is introduced, improving operation in comparison with that of known apparatus: increasing the operating length of the tube, increasing the intensity, and decreasing the parasitic background. (tr-auth)

43920 NUCLEAR MAGNETIC RESONANCE SPECTROSCOPY IN SUPERCONDUCTING MAGNETIC FIELDS. F. A. Nelson and H. E. Weaver (Varian Associates, Palo Alto, Calif.). Science, 146: 223-32(Oct. 9, 1964).

The performance characteristics of a high-resolution nuclear magnetic resonance spectrometer with a superconducting magnet are discussed. A system has been made to operate at twice the frequency and field intensity of 100 Mcy/sec (23.4 kilogauss). Even though the maintenance of spectrometers with superconducting magnets requires rather specialized skills, this type of instrumentation makes possible analyses that have not been possible with presently available instruments. (P.C.H.)

43921 ATOMIC CLOCKS. I. PRINCIPLES OF OPERATION. Ed. Rentsch (Observatoire Cantonal, Neuchatel, Ger.). II. DEVELOPMENTS. P. Kartaschoff (Laboratoire Suisse de Recherches Horlogeres, Neuchatel, Ger.). Suisse Horlogere, No. 2, 8p.(Aug. 1963). (In French)

The operational principles of atomic clocks were described with consideration of atomic oscillations. Electromagnetic waves, interactions between atoms and electromagnetic waves, specific characteristics of microwave transitions, resonance length, and the microwave transitions used for the regulation of atomic clocks were the oscillations discussed. Atomic clocks using masers, atomic-jet resonators, and gas cells were briefly described. The use of atomic clocks to attain improved precision in time signals is considered. (J.S.R.)

43922 GALVANOMETER PEDESTAL–SMALL /SAND-50/ (Engineering Materials). (Sandia Corp., Albuquerque, N. Mex.). (CAPE-1126)

Drawings (16) are presented for a pedestal used to isolate light-beam galvanometers from vibrations found in a nonindustrial building to a degree that makes it practical to use high-sensitivity galvanometers at distances of four meters from their scales. The design consists of a large mass suspended from a frame. The mass is a two-deck assembly of flat steel plate. The upper deck is polished to afford a flat working surface. The plate is 2 in. thick, 34 in. sq, and weighs 655 lb. The lower deck is suspended from the frame by diagonal springs between the frame and the lower deck. It is a plate 4 in. thick, 30 in. sq, and weighs 1060 lb. The 54 in. high frame is constructed of 11 gauge steel plate and steel angles $2\frac{1}{2}$ in. × $2\frac{1}{2}$ in. × $\frac{1}{4}$ in. Four $8\frac{3}{4}$ in. high × 6 in. in dia. oil-filled dashpots positioned between the floor of the frame and the lower deck damp out motion imparted to the mass. The suspended mass can be bolted to the frame to facilitate transportation. The pedestal weighs 1800 lb. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

43923 THERMOMETER COMPARATOR /SAND-48/ (Engineering Materials). (Sandia Corp., Albuquerque, N. Mex.). (CAPE-1076)

Drawings (8) are presented for a comparator designed for liquid-in-glass thermometer calibration. The comparator is a thermally insulated 0.125 in. plexiglass transparent chamber. It is 20 in. high, 7.31 in. in dia, and is attached to a Statham SD6 test chamber. The equipment is mounted on an aluminum cabinet $8\frac{1}{4}$ in. high and 9 in. sq. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

43924 AUTOMATIC PROGRAMMING AND RECORDING SYSTEM (APAR-3G) (Engineering Materials). (Sandia Corp., Albuquerque, N. Mex.). (CAPE-1053)

The APAR-3G system is an automatic programming, controlling, and recording machine which is readily adaptable to a wide variety of automated data acquisition and control system applications. It is physically and logically modular to permit the assembly of minimum or maximum capability machines by use of off-the-shelf building blocks. This system can perform the necessary acquisition and control in a typical factory environment and can generate an output (for data reduction) which is compatible with available computer systems. Drawings (91) are included. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

43925 RADIATION GAUGING BREAKTHROUGH. Charles O. Badgett (Industrial Nucleonics Corp., Columbus, Ohio). 26p. (CONF-676-1)

From 10th National Analysis Instrumentation Symposium, San Francisco, June 1964.

A pulse frequency digital ratio computer is described, which permits angular measurements accurate to 5 seconds of arc in low radiation fields. The computation methods and their application to process measurements are outlined. (D.C.W.)

43926 APPARATUS FOR CORRECTING SENSITIVITY VARIATIONS IN PHOTOMULTIPLIER TUBES. Lloyd D. Stephens (to U. S. Atomic Energy Commission). U. S. Patent 3,149,968. Sept. 22, 1964.

A method and apparatus for making a filter, which cor-

rects point-to-point variations in sensitivity of the cathode surface of a phototube, were developed. The photocathode is incrementally excited by the raster pattern of an oscilloscope while the phototube output is used to modulate the beam intensity of a geometrically similar raster on another oscilloscope, which has a photographic film attached. The film is thereby exposed in accordance with the incremental response pattern of the phototube. The film negative, upon development, has a transmissibility pattern inversely related to the sensitivity pattern of the photocathode. Superposition of the film negative in proper orientation on the phototube face thus normalizes the sensitivity to a uniform level. (AEC)

Radiation Detection

Refer also to abstracts 43390, 44260, 44736, and 44935.

43927 (AAEC/TM-265) A GAMMA-RAY SPECTROMETER WITH HIGH RESOLVING POWER. A. McG. Beech, J. K. Parry, and D. F. Urquhart (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Aug. 1964. 19p.

The high resolving power of solid-state detectors can be utilized for gamma rays by using a silicon surface barrier detector in a two-crystal coincidence spectrometer. An instrument of this type, using a plastic phosphor for the second detector, is described. It is shown that the resolution obtained, less than 13 kev for ^{137}Cs is close to the limit set by amplifier noise and other basic limitations. The observed counting efficiency is found to be in reasonable agreement with theory. Spectra obtained from sources of ^{192}Ir, ^{137}Cs, and ^{60}Co are shown. (auth)

43928 (EIR-70) TIME-OF-FLIGHT MODULE FOR THE TRANSISTORIZED RCL-256 CHANNEL ANALYZER. A. Baechli and K. Behringer (Switzerland. Eidgenossisches Institut für Reaktorforschung, Wurenlingen). Aug. 1964. 32p.

The time-of-flight module developed for the transistorized RCL-256 channel analyzer to measure thermal spectra from a neutron chopper is described. Circuit diagrams and photographs are included. (R.E.U.)

43929 (EUR-1882.e(p.36-8)) IMPROVEMENT OF RADIOISOTOPE METHODOLOGY. (Netherlands. Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen).

Reproducibility of sample preparations was studied with GM-counters. Results obtained indicate that a single determination for gamma- and hard beta-emitters gave statistical accuracy of 0.8%. By multiple countings, the statistical accuracy was brought to 0.4%. Mixture tests for liquid scintillation preparations were conducted and the best systems were found to be dioxane plus nephthalene plus cellosolve plus water. Simultaneous counting of Ca and Sr and quantitative interpretation of micro-autoradiograms by track counting in liquid emulsions are being investigated. Possibilities offered by solid state detectors for their potential value in biological research were investigated and compared with GM-counters. Instruments developed include an automatic micro-freeze dryer; an anti-coincidence counter for low-level beta measurement; a beta-gamma coincidence counter for neutron flux measurement through irradiation of gold foils; and a multiscaling unit for measurement of isotope half lives of long duration. (H.M.G.)

43930 (IDO-16953) AN EIGHT-INPUT ADAPTER FOR A CN-1024/211 TIME OF FLIGHT ANALYZER. R. I. Little and E. P. Elkins (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). July 1964. Contract AT(10-1)-205. 30p.

A Technical Measurement Corporation Model CN-1024/211 time-of-flight analyzer was modified for instantaneous external memory control and external variable initial delay using the internal clock source. An external system was designed and constructed. This unit allows splitting the 1024 channel memory into 1, 2, 4, or 8 sections for use with a like number of separate inputs, in addition to some other interesting possibilities. It also contains an initial delay circuit, which uses the analyzer's clock for generating up to 65,504 channels of delay in increments of 32 channels. The external circuitry is also applicable to most other analyzer plug-ins and to the older CN-110 analyzer. (auth)

43931 (IFA-M.32) RADIATION MEASUREMENTS AT THE BETATRON OF THE INSTITUTE OF ATOMIC PHYSICS. M. Grecescu (Academia R.P.R. Institutul de Fizica Atomica, Bucharest). [1963]. 19p.

A thick-walled ionization chamber was used to measure the beam intensity from the IAP Betatron. The aluminum chamber design and performance are discussed. (R.E.U.)

43932 (IFA-M-34) EXPERIMENTAL APPARATUS AND TECHNIQUES EMPLOYED IN STUDYING THE (γ,Tn) REACTIONS USING A 31-Mev BETATRON. G. Baciu (Academia R. P. R. Institutul de Fizică Atomică, Bucharest); B. Minetti, C. Molino, L. Pasqualini, and G. Piragino (Turin. Università. Istituto di Fisica). 1964. 14p.

Descriptions of the experimental apparatus and techniques employed for determining the excitation functions of the (γ,Tn) reactions in light and medium elements using a 31-Mev betatron are given. Recent determinations of the cross sections for the production of photoneutrons from light and medium elements have showed the presence of complex structure in the giant resonance region. In order to effect a comprehensive study of the giant resonance fine structure in the (γ,Tn) reactions, a 4π (Halpern-type) neutron detection system was constructed. This experimental procedure allowed us to measure yields with a statistical error less than 0.6% for samples of 2 ... 3 gr/cm^2. The energy bin chosen for the cross section analysis is 0.5 Mev. The energy resolution is determined by the ±20 kev stability of the betatron energy. These conditions made useful the Penfold-Leiss experimental data analyzing method without introducing any smoothing. A method of betatron energy control is described. The first results obtained from the study of the reaction $^{16}O(\gamma,Tn)$, are also indicated. (auth)

43933 (ISS-64/26) PERFORMANCE OF A CURVED ACOUSTIC SPARK CHAMBER. U. Amaldi, Jr. (Italy. Istituto Superiore di Sanita, Rome). July 1, 1964. 13p. (CONF-560-5)

From Conference on Film-Less Spark Chamber Techniques and Associated Computer Use, Geneva, Mar. 1964.

A cylindrical spark chamber is described. Its useful opening angle is 130° and its radius is 55 cm. The angular position of a spark in a gap is determined by measuring the time-of-flight of the sound from the spark to two acoustic probes of the solid dielectric type. It is shown that if the spark is energetic, the acoustic shock wave propagates along the curved gap preserving its rise-time. With more than two probes in each gap an accuracy similar to the one

observed in flat chambers can thus be obtained. The acoustic spark chamber is to be a hodoscope to be added to a counter system. (auth)

43934 (LA-3132-MS(p.76-83)) LOS ALAMOS SMALL ANIMAL COUNTER: LASAC III. C. R. Richmond, J. E. London, J. S. Findlay, and J. E. Furchner (Los Alamos Scientific Lab., N. Mex.).

Design features and operational characteristics are described for a completely automated liquid-scintillation, small-animal counter. The system gave good results in measurements of small amounts of γ-emitting radionuclides in mice and rats. Good results were also obtained when several radionuclides were counted simultaneously. (C.H.)

43935 (LA-3132-MS(p.142-3)) A TWO-CRYSTAL GAMMA-RAY SPECTROMETER. M. J. Fulwyler (Los Alamos Scientific Lab., N. Mex.).

Design features of a γ spectrometer are described. The instrument uses 2 thin-window 8×4-in. NaI(Tl) crystals that provide a highly sensitive and flexible system for detecting, identifying, and quantitating γ-emitting isotopes in both animate and inanimate samples. (C.H.)

43936 (MIT-952-1(p.163-95)) INSTRUMENTATION TECHNIQUES. (Massachusetts Inst. of Tech., Cambridge. Radioactivity Center).

Data are presented on the design, calibration, and performance of a large volume scintillation counter for Rn counting; an automated α–γ correlation system designed to investigate nuclear properties in the trans-lead region; a small vacuum system for the preparation of thin-film evaporated α sources; Li-drifted Ge semiconductor detectors for γ-ray spectrometers; semiconductors for Rn counter applications; a γ scanning system using new crystal suspensions; and a γ-ray-focusing collimator. (C.H.)

43937 (NP-14265) CONSTRUCCION Y PUESTA A PUNTO DE UN SISTEMA PARA MEDIDAS PRECISAS DE DIFUSION CENTRAL DE RAYOS X EN ESCALA ABSOLUTA. Informe No. 111. (Construction and Completion of a System of Precise Measurement of the [Scattering] of X-rays on an Absolute Scale. Report No. 111). Alberto F. Bonfiglioli (Argentina. Comisión Nacional de Energía Atómica, Buenos Aires). 1964. 13p.

An installation designed to measure the central scattering of x rays by means of a goniometer with proportional counter is described. The system, operating with strictly monochromatic radiation, makes possible absolute measurements with excellent precision. The construction, control, and operation are discussed. The improvement of the results obtained is facilitated by the geometry of the installation, which corresponds to ideal conditions of infinite and linear collimation. (tr-auth)

43938 (ORNL-P-437) THE USE OF MULTIPARAMETER DISPLAYS IN STUDIES OF RADIOACTIVE NUCLEI. G. Davis O'Kelley (Oak Ridge National Lab., Tenn.). [Aug. 31, 1964]. Contract W-7405-eng-26. 12p. (CONF-593-6)

From Conference on the Automatic Acquisition and Reduction of Nuclear Data, Karlsruhe, Ger., July 1964.

The use of two-dimensional map displays (CRT) of a multiparameter pulse-height analyzer's 20,000-word, ferrite-core memory in nuclear spectroscopy is discussed. The display is used to evaluate the experimental situation at any time from setup to completion. (R.E.U.)

43939 (RFX-97) AN APPARATUS FOR INVESTIGATION OF NEUTRON POLARIZATION IN THE Mev REGION. Olav Aspelund (Aktiebolaget Atomenergi, Studsvik, Sweden). June 29, 1962. 29p.

An experimental facility to be used in measuring neutron polarization in the Mev region is described. The apparatus uses an analyzer of known polarization for neutron-producing reactions or a neutron beam of known polarization for scattering experiments. Background is reduced by time-of-flight techniques. Electronic instrumentation is described. (R.E.U.)

43940 (TID-7697(p.5.5.1-10)) FAST NEUTRON DOSIMETRY WITH FISSION MONITORS. S. B. McRickard (Brookhaven National Lab., Upton, N. Y.). (BNL-7574)

The problem of determining neutron exposures and the neutron energy spectrum above 1 Mev can be solved by fission threshold monitors using ^{238}U, ^{232}Th, and ^{237}Np. A description is given of the experience of using these flux monitors in test capsules which were irradiated in the Brookhaven Graphite Reactor and the MTR. Representative results are tabulated. (D.L.C.)

43941 (TID-7697(p.5.9.1-3)) SUB MINIATURE ION CHAMBERS. R. G. Bock.

A sub-miniature ion chamber is described which can be used to determine flux levels and profiles in reactors. The chamber is less than 0.5 in. long and uses the $^{10}B(n,\alpha)$ reaction. Specifications for the chamber are given. (D.L.C.)

43942 (TID-21202) A SEMICONDUCTOR DETECTOR FAST NEUTRON SPECTROMETER (thesis). Edward Stephen Kenney (Pennsylvania State Univ., University Park). Sept. 1962. 54p.

A fast-neutron spectrometer system using semiconductor detectors was constructed to measure the energy spectra of neutrons from a reactor core, which also creates a high gamma field. Stable and reliable operation was found for core leakage spectra at 0.8 to 10 Mev. (R.E.U.)

43943 (UCRL-9457) THE FOG, CLOUDY, AND FAIR PROGRAMS FOR BUBBLE CHAMBER DATA REDUCTION. Howard S. White, Shirley S. Buckman, Denis E. Hall, Elizabeth Hurwitz, Loren B. Meissner, Joan C. Smith, and F. Russell Stannard (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1960. Contract W-7405-eng-48. 46p.

A general description is given of the FOG, CLOUDY, and FAIR programs developed for the IBM 704 computer. The programs perform the spatial reconstruction of events photographed in a bubble chamber and calculate the momentum components of the tracks. The parameters are transformed into special reference frames, quantities of physical interest are derived, and various kinematic constraints are applied. The results of the calculations for each event appear as page output, and selected parameter distributions for a group of events can be obtained as CRT displays. Notable features of the programs include the manner in which human and digitizer errors are largely eliminated, and the extensive use made of library tapes for storing data. The latter makes it possible to output all the relevant information concerning an event as a single unit thereby reducing the amount of external correlation required of the physicist. (auth)

43944 (UCRL-11521) LRL 25-INCH BUBBLE CHAMBER. Luis W. Alvarez, J. D. Gow, Frank Barrera, Glenn Eckman, Jim Shand, R. Watt, Duane Norgren, and H. P. Hernandez (California. Univ., Berkeley. Lawrence Radiation Lab.). July 8, 1964. Contract W-7405-eng-48. 8p. (CONF-550-85)

From The International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

The 25-in. hydrogen bubble chamber used with the Bevatron is described. The expansion and optical systems, and some initial photographic results are shown. (R.E.U.)

43945 (CEA-tr-A-1525) METHODES CHIMIQUES DE DOSIMETRIE. (Chemical Methods of Dosimetry). W. Minder. Translated into French from Chimia (Aarau), 12: 17-30(1958). 50p.

The experimental and theoretical bases on which the dosimetry of ionizing radiations with chemical reactions depends are reviewed. The most important areas for the application of chemical dosimetry are presented. The advantages and disadvantages of each of the methods of practical application are discussed. A detailed analysis was made of some fundamental problems of dosimetry whose solution is possible with radiation chemistry. The effects of the polarization effect and the recombination effect were discussed as problem areas where radiochemistry could be advantageously used. 120 references. (J.S.R.)

43946 DIGITAL COMPUTER DETERMINATION OF ALPHA SOURCE ACTIVITY. Donald Robbins and W. E. Taylor (Sandia Corp., Albuquerque, N. Mex.). Commun. ACM (Assoc. Computing Machinery), 7: 34-8(Jan. 1964). (TID-18404; SCDC-3097)

A technique for determining the activity and homogeneity of an alpha source is described, involving digitization of the photographic plate image of the source with subsequent computer manipulation of the digital image. (D.C.W.)

43947 HYDROGEN AND HELIUM BUBBLE CHAMBERS. D. F. Shaw (Oxford Univ.). Cryogenics, 4: 193-203(Aug. 1964).

A review is presented of design and operation characteristics of H_2 and He bubble chambers. Attention is given to the refrigeration, temperature control, and construction aspects of operation of these chambers. (T.F.H.)

43948 ABSOLUTE MEASUREMENT OF β RAY-FLUX DENSITY. Yasushi Kawada and Akira Sekiguchi. Denki Shikensho Iho, 28: 149-55(Feb. 1964). (In Japanese)

A method is given for absolute measurement of β ray flux density at a definite distance from a Ra (D + E) source. The calibrated β ray flux is used for the calibration of β ray flux density meters, and the measurements of counting efficiencies of β ray detectors such as GM tubes (in accordance with the Japanese Measurement Law). A proportional counter with a small defined aperture has been constructed for the absolute measurement. The distance between the aperture and the source is finely adjustable by a screw-mechanism. The value of β ray flux density is given as the ratio of the counting rate to the area of aperture with some corrections made for β ray absorption at the mylar foil, scattering at the edge of the aperture, and geometry. Beta ray flux density meters are easily calibrated by comparing the counting rate value with the β ray flux density at the counter-position. (auth)

43949 OPTIMUM THICKNESS OF Dy FOILS FOR THERMAL NEUTRONS DETECTION IN GRAPHITE. L. Fava (CESNEF, Milan), V. Sangiust, E. Vigliano, and S. Terrani. Energia Nucl. (Milan), 11: 432-4(Aug. 1964).

The variation of thermal neutron counting rate with thickness of Dy foils in graphite was determined. Experimental values were compared with a calculation made taking in account β rays self absorption and neutron flux depression caused by the foil. (auth)

43950 A SCATTERING CHAMBER FOR USE WITH SOLID-STATE DETECTORS. G. M. Marcazzan and G. Pappalardo (Laboratori CISE, Milan). Energia Nucl. (Milan), 11: 509-13(Sept. 1964).

A scattering chamber, designed for the study of (d,p) and (d,α) reactions with solid state detectors, is described. The chamber features precise positioning of the target and of the counters (both movable and fixed), a simple method of rotation of the counter around the target under vacuum, and ease of aligning the chamber about the beam direction. The specifications and the performances of an accurate current integrator and of a particular detecting device for discriminating between alpha and proton energy spectra are also presented. (auth)

43951 SOME CONSIDERATIONS ON THE DESIGN AND CIRCUITRY FOR A NEUTRON MONITOR. I. N. Kapustin, B. A. Kotkin, V. S. Smirov, and E. T. Frantsuz (Polar Geophysical Inst., Academy of Sciences, Kola, USSR). Geomagnetism Aeronomy, 3: 891-5(1963).

The requirements for the design and circuitry of a neutron monitor which ensures that its efficiency will be maintained with an accuracy of ~0.1% over a long period of time are discussed. (auth)

43952 MODIFIED MONEY SAFE AS CORE FOR ECONOMICAL SCINTILLATION DETECTOR SHIELD. George L. Toombs (Oregon State Board of Health, Portland). Health Phys., 10: 761-2(Oct. 1964).

Adequate shielding around the scintillation detector and sample is necessary in low-level γ spectrometry. A shield is described that was constructed from a used Mosler model 6E standard money safe enclosed in lead bricks. The 4-in. steel door did not require additional shielding. The total weight of the completed shield was about 7000 lb and total cost was $1,360. (C.H.)

43953 PERFORMANCE OF A GAS-FILLED COUNTER. A. A. Abdullaev and B. K. Khaitov (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk, No. 2, 56-8(1964). (In Russian)

Investigations of ethylene- and hydrogen-filled counters showed the optimum efficiency for gas-filled counters at ethylene and hydrogen pressures of 10 and 70 mm Hg, respectively. A 250-v plateau with a 7% dip and counter effective areas within 1100 to 1300 v and 1050 to 1300 v, respectively, were obtained. (R.V.J.)

43954 SEMICONDUCTOR SURFACE-BARRIER COUNTERS. B. I. Khrushchev, Yu. T. Trombachev, and V. F. Petrunin (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk, No. 2, 59-63(1964). (In Russian)

It is shown that Si surface-barrier counters using ^{10}B can be used for counting thermal neutrons in the presence of strong magnetic fields. However, the counter must be protected against strong light sources, and the sensitivity of the counter to the γ background should be considered. (R.V.J.)

43955 MEASUREMENT OF RADIATION DOSAGE. SYSTEMS USED DURING CLINICAL AND RADIOBIOLOGICAL STUDIES. S. J. Malsky, B. Roswit, C. C. Amato, H. M. Jones, B. Ried, and H. Patterson. J. Am. Med. Assoc., 187: 839-41(1964).

The development and use of properly screened and shielded low-Z (atomic number) radiophotoluminescence (RPL) glass rod dosimeters has led to its use in a variety of radiation therapy and radiation biology situations. The development of 2 types of thermoluminescent (TL) phosphors, encapsulated in a heat, chemical, and electrical resistant glass or one of the loose phosphors, as well as

reader systems will enable radiation studies to be undertaken in the low energy, low dose range, to the high energy and high dose ranges. The use of one or more types of thermoluminescent dosimetry systems (CaF_2: Mn, LiF) appear to have wide application for in vivo use with discrete source implants (Ra, ^{192}Ir, Rn, ^{60}Co) in radiation therapy, nuclear medicine, radiation biology, and in the field of diagnostic radiology with its many areas of investigation. The in vivo techniques as developed and established for RPL glass dosimetry are applicable for use in TL dosimetry. (Excerpta Med., Sect. XXIII, 1: (Sept. 1964))

43956 A COLLIMATOR FOR SCANNING WITH LOW-ENERGY PHOTONS. C. C. Harris (Oak Ridge National Lab., Tenn.), J. C. Jordan, M. M. Satterfield, Jack K. Goodrich, H. L. Stone, and Rebecca Hill. J. Nucl. Med., 5: 653-6(Sept. 1964). (ORNL-P-184)

A collimator was made of formed, tapered, hexagonal tubes built up into an array of necessary size. A foil thickness of 0.005 in. was used. The final assembly composed of 109 tubes had an estimated transmission of 85 to 90%. Isoresponse curves plotted for ^{125}I and ^{197}Hg did not vary significantly. However, design of the apparatus proved to be better adaptable to ^{197}Hg work than ^{125}I work. It was concluded that for energies around 70 kev the collimator provided resolution comparable to that of 3-inch, 61-hole collimators, with the advantage that the on-target count rates would be almost doubled. (H.M.G.)

43957 SEMICONDUCTOR ION CHAMBER—A NEW DETECTOR FOR RADIOACTIVE RADIATION. Per Arne Tove. Kosmos Stockholm, 38: 139-66(1960). (In Swedish)

The design, theory of operation, amplification, and performance of a semiconductor ion chamber are discussed. (C.E.S.)

43958 AN IMAGE INTENSIFIER TUBE WITH HIGH GAIN FOR 1 Mev PHOTONS. Donald T. Green (Picker X-Ray Corp., Cleveland) and Wilfrid F. Niklas. Mater. Evaluation, 22: 465-70(Oct. 1964).

A vacuum image intensifier sensitive to gamma radiation in the Mev region is discussed in detail. This new image tube contains a lead intensifying disk inside the evacuated tube envelope used to convert the primary gamma rays into softer, secondary electromagnetic and/or particle radiation. The secondary radiation is converted into "visible" photons in a phosphor screen; these photons are converted into photoelectrons by a photocathode deposited directly onto the energy converting pickup pack. The photoelectrons are accelerated and focused onto a cathodoluminescent phosphor screen. The visible output image is an exact replica of the flux density distribution in the primary gamma ray beam. The various energy conversion processes as well as the geometric and electron optical image tube design are discussed in detail. The applicable viewing methods, namely viewing through an optical system, still and motion picture photography, and closed-circuit TV viewing, are outlined. The performance of the image intensifier tube for 1 Mev photons with closed-circuit TV viewing (image orthicon pickup) is illustrated by numerous examples. It is shown that 4 per cent contrast and 8 per cent detail sensitivity can be achieved quite readily. The obtained results indicate that fine cracks (0.010 in. wide) can be perceived in steel 6 in. thick. And 6 and 3 in. steel penetrameters, embedded in 22½ in. solid rocket fuel, are also imaged quite clearly with the gamma ray image intensifier using ^{60}Co radiation. The conclusion may be drawn that this new tube is a useful tool for nondestructive testing utilizing gamma radiation. (auth)

43959 THE STATISTICAL ERROR IN THE MEASURING TIME OF PULSE-COUNT SELECTION. L. Kranz. Mitteilungsbl. Strahlungsmessgeraete, 5: No. 11, 11-12 (Feb. 1964). (In German)

A rigorous derivation is made for the general case of ν-fold statistical errors in pulse-counting preselection. The error interval for the measurement time for ν = 1, 2, and 3.1 is tabulated when T is the mean value of the measurement time. (J.S.R.)

43960 A DIGITIZED SPARK CHAMBER FOR AUTOMATIC DATA RETRIEVAL. J. Bounin, M. J. Neumann, R. H. Miller, and H. Sherrard (Univ. of Chicago). Nucl. Instr. Methods, 30: 34-44(Nov. 1964).

A spark chamber is described in which the usual plate electrodes are replaced by wire grids. Toroidal ferrite memory cores threaded on these wires are set by the spark current and yield information about spark location when they are interrogated by circuits like those used in computer memories. This system may be read out very rapidly (on the order of 0.1 μsec, and the resolution is about 0.4 of a wire spacing. Comparisons are made with other systems proposed for automatic retrieval spark chambers, and test results from runs in a cyclotron beam are given. The chamber and associated circuits were designed for on-line operation with the Maniac III computer. (auth)

43961 A DIGITISED MICROMETER EYEPIECE FOR MEASUREMENTS IN NUCLEAR EMULSIONS. D. A. Evans and F. Foster (Oxford Univ.). Nucl. Instr. Methods, 30: 93-8(Nov. 1964).

A bifilar eyepiece in which the motions of both cross wires are digitized, enabling the readings to be punched out automatically on computer tape is described. It is found that the coordinates of a grain in the emulsion can be measured with an accuracy of 0.05 μ for each axis. It is also shown that the error introduced by digitizing is much less than the setting error of the cross-wires on a grain image. (auth)

43962 A DRIVE AND WAVEFORM GENERATOR FOR MÖSSBAUER EXPERIMENTS UTILIZING A MULTICHANNEL ANALYSER. T. E. Cranshaw (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Nucl. Instr. Methods, 30: 101-5(Nov. 1964).

A flexible system for performing Mössbauer experiments using an electromechanical transducer in conjunction with a multichannel analyzer is described. Waveforms are generated which make good use of the available time without involving high order harmonics. Synchronism of the generated waveform and the analyzer is automatically ensured. (auth)

43963 AN IMPROVED SUMMING COMPTON GAMMA-RAY SPECTROMETER. J. H. Aitken (National Research Council, Ottawa). Nucl. Instr. Methods, 30: 116-22(Nov. 1964).

An analog computer using semiconductor logarithmic elements is used to examine the coincident pulse pairs from a summing Compton spectrometer for compatibility with the Compton scattering equation for the particular scattering angle being used. With the aid of this circuit, the total absorption fraction of the spectrometer can be raised almost to 100% by identifying and rejecting electronically those coincidences in which some of the energy of the incident photon has escaped from either detector. At the same time, the polarization sensitivity of the Compton spectrometer is also improved since coincidences in which multiple scattering has taken place are rejected. The

system can also be used to make the spectrometer telescopic, selecting electronically rather than by heavy collimators the incident direction of interest. (auth)

43964 AUTOMATIC DEVICE FOR MEASURING TRACK WIDTHS IN NUCLEAR EMULSION. H. Annoni, P. Poubeau, G. Baumann, H. Braun, and E. Christophel (Université, Strasbourg). Nucl. Instr. Methods, 30: 125-30(Nov. 1964). (In French)

An automatic device for measuring the width of particle tracks in emulsion is described. The electric signal of a photomultiplier which detects the relative blackness of the particle tracks is directly used by an electronic apparatus. This is a method of a quick and accurate counting. (auth)

43965 APPLICATION OF AN IMPROVED IONOGRAPHIC PHOTOMETER IN THE DISCRIMINATION OF CHARGES GREATER THAN OR EQUAL TO 3 IN NUCLEAR EMULSION. R. Stein and H. Braun (Université, Strasbourg). Nucl. Instr. Methods, 30: 131-4(Nov. 1964). (In French)

The resolution of the ionographic photometer for studies of the emission of heavy fragments with $Z \geq 3$ in reactions induced by 25-Bev protons was improved by using a second slit system. (D.C.W.)

43966 A LOW NOISE CHARGE SENSITIVE PREAMPLIFIER FOR SEMICONDUCTOR DETECTORS. H. J. Langmann and O. Meyer (Kernforschungszentrum, Karlsruhe, Ger.). Nucl. Instr. Methods, 30: 135-7(Nov. 1964). (In German)

A charge-sensitive, low-noise preamplifier is described. The amplifier alone showed a rms noise corresponding to a charge of 195 ion pairs. A comparison of the signal of merit of various input valves showed the type EC 1000 to be the most promising. A measurement of the conversion electrons of ^{137}Cs with a semiconductor detector gave a resolution of the 625-kev electrons of 2.9 kev. Pulses of a generator simulating nearly the same charge as that corresponding to the 625-kev electrons showed a full width at half maximum of 2.7 kev. This measurement is an indication that the Fano-factor of the ionization noise of semiconductor detectors must be lower than that of gas ionization devices. (auth)

43967 ON PULSE SHAPE DISCRIMINATION IN ANTHRACENE. A. Suhami and D. Ophir (Israel Inst. of Tech., Haifa). Nucl. Instr. Methods, 30: 141-4(Nov. 1964).

The pulse shape of scintillation pulses in anthracene crystal was investigated. The different charge distributions due to protons and electrons were measured as a function of the time of equal charge collection and energy. (auth)

43968 A NEW FAST TRANSMISSION DETECTOR OF CHARGED PARTICLES. J. E. Draper (Yale Univ., New Haven and Univ. of California, Davis). Nucl. Instr. Methods, 30: 148-50(Nov. 1964).

A transmission detector of charged particles is described and analyzed. It features large area ($\sim 10^4$ mm^2), thin windows (2 μ nickel), fast response (coincidence $\tau \sim 5 \times 10^{-9}$ sec), and large signal (gas gain ~5000 for ion collection). (auth)

43969 A SCATTERING CHAMBER FOR USE WITH SOLID STATE DETECTORS. M. A. Abuzeid, A. T. Baranik, M. I. El-Zaiki, V. J. Gontchar, S. M. Morsy, and I. I. Zaloubovsky (Atomic Energy Establishment, Cairo). Nucl. Instr. Methods, 30: 151-3(Nov. 1964).

A scattering chamber for use with solid-state detectors is described. It permits the use of five different targets without destroying the vacuum. The scattering chamber allows a simultaneous and independent motion of two detectors in the radial and azimuthal directions. The stopping foils, placed before the detector, can be changed in the presence of the beam without destroying the vacuum. (auth)

43970 PULSE HEIGHT–ENERGY RELATIONSHIP OF A LIQUID SCINTILLATOR FOR ELECTRONS OF ENERGY LESS THAN 100 kev. D. L. Horrocks (Argonne National Lab., Ill.). Nucl. Instr. Methods, 30: 157-60(Nov. 1964).

The pulse height-energy relation of a liquid scintillator for electrons with excitation energies less than 81 kev was observed to deviate from the linear relation for higher energy electrons. A smooth, almost linear curve was obtained with a small (approximately 2 kev) positive energy intercept. It was shown that the 6.6-kev Mn K edge radiations and the 13.4-kev Rb K x rays can be counted in a liquid scintillator system. (auth)

43971 FAST NEUTRON SPECTROSCOPY IN A POOL-TYPE REACTOR WITH ACTIVATION DETECTORS. G. Ben-David, E. Nardi, and M. Pasternak (Soreq Research Establishment, Yavne, Israel). Nucl. Sci. Eng., 20: 281-9 (Nov. 1964).

The fast-neutron spectrum was measured at several positions in the IRR-1 pool-type reactor using seven activation detectors. The spectrum was calculated by the simultaneous analysis of the data from the seven detectors. Adjacent to the core the spectrum was found to be close to the fission spectrum, with a slight dip between 3 and 4.5 Mev. At increasing distances from the core, the spectrum becomes harder, with a pronounced dip between 3 and 4.5 Mev. (auth)

43972 ELECTRONICS IN MODULAR CELLS. J. Furet and J. Weill (Centre d'Etudes Nucleaires, Saclay, France). Onde Elec., 44: 737-9(July-Aug. 1964). (In French)

The evolution of the present electronic technology and the nature of the electrical signals to be analyzed, in the case of neutron detectors, led to the development of modular elements that should be a satisfactory solution to the problems of reliability, maintenance, and standardization. The results of the study on the adaptation of modular cell electronics to measurement assemblies for neutron monitoring and control are described. The advantages are analyzed. (tr-auth)

43973 CHARACTERISTICS OF MODULES FOR MEASURING APPARATUS FOR NEUTRON CONTROL OF ATOMIC REACTORS. J. Bourdel (Centre d'Etudes Nucleaires, Saclay, France). Onde Elec., 44: 740-7(July-Aug. 1964). (In French)

The evolution of semiconductor technology has made it possible to develop completely transistorized measurement assemblies both for current and pulse measurements. The performances of the measurement devices for neutron control are tabulated. The most important characteristics are those concerning the application of fast electronics to neutron flux measurements with fission chambers and the utilization, for the measurement of low d-c currents, of varicap diodes having drifts of the order of 10^{-14} amp/°C. (tr-auth)

43974 CALCULATION OF THE NON PROPORTIONAL ENERGY RESPONSE OF A 3" × 3" NaI(Tl) CRYSTAL. P. O. Tjem (Universitet, Oslo). Phys. Norvegica, 1: 235-7 (1964).

The relation between the energy loss per unit path length of electrons and the pulse height per unit energy (L/E_γ) from a scintillation counter is investigated. It is shown

that the light output per unit energy (L/E_γ) is a function of the mean energy loss per unit path length of the electrons produced by the gamma rays which are absorbed in the crystal. With this method, the energy response of the scintillation crystal is readily calculated from measurements of L/E_γ for two gamma energies. (auth)

43975 CONSTRUCTION PROBLEMS OF LIQUID HYDROGEN BUBBLE CHAMBERS (REVIEW). G. K. Kliger, V. Z. Kolganov, A. V. Lebedev, V. T. Smolyankin, and A. P. Sokolov. Pribory i Tekhn. Eksperim., No. 3, 5-25(May-June 1964). (In Russian)

A survey of basic features of the design and construction of liquid hydrogen bubble chambers is given. Basic parts of bubble chambers, exposure of the chamber, illuminators and glass, temperature control, expansion mechanisms, radiation screens, auxiliary cooling equipment, and safety problems are considered. The 55-cm bubble chamber of the Institute of Theoretical and Experimental Physics is discussed and compared with other large bubble chambers in the U. S. and Europe. (auth)

43976 LINE SHAPE OF CASCADE GAMMA SPECTROMETER. V. F. Grushin and E. M. Leikin (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 3, 33-5(May-June 1964). (In Russian)

An expression for the line shape of a cascade γ spectrometer is obtained on the basis of the theorem on sums of random numbers of random addends and the model of average light collection. (tr-auth)

43977 MULTICHANNEL COINCIDENCE SPECTROMETER BASED ON AI-100-1. A. P. Bogdanov and E. I. Firsov (Inst. of Physics, Academy of Sciences, Belorussian SSR). Pribory i Tekhn. Eksperim., No. 3, 35-9(May-June 1964). (In Russian)

A multichannel γ spectrometer is described, which enables γ and γ-γ coincidence spectra to be measured and excited-state lifetimes in the interval 1 to 100 μsec to be determined (with the possibility of increased range on the side of larger times). The spectrometer is assembled using industrially produced apparatus. Block schemes are presented for data output from the AI-100-1 onto automatic printing apparatus EPP-09 and from the time unit. A fast coincidence scheme for work with slow scintillators with resolving time of 5×10^{-8} sec is described. (tr-auth)

43978 ON THE EFFICIENCY OF GAS DISCHARGE COUNTERS FOR WEAKLY IONIZING PARTICLES. A. I. Filatov. Pribory i Tekhn. Eksperim., No. 3, 40-3(May-June 1964). (In Russian)

A study was made of the dependence of the efficiency of weakly-ionizing-radiation counters, filled with electronegative gases, on the concentration of the electronegative addition, the total pressure of the filler, and geometrical parameters. Calculated and experimental results are given for neon counters with bromine added. (M.I.T.)

43979 MECHANISM PRODUCING MULTIPLE PULSES IN HALOGEN COUNTERS. A. I. Filatov. Pribory i Tekhn. Eksperim., No. 3, 44-6(May-June 1964). (In Russian)

The mechanism of multiple-pulse formation in halogen G-M counters is considered. The relations between radiocircuit elements by which multiple pulses are allowed or prohibited are determined. Practical suggestions for the use of halide counters are given. (tr-auth)

43980 4-π COUNTER FOR MEASURING THE RADIOACTIVITY OF GASEOUS PRODUCTS. O. I. Kostochkin, K. A. Petrzhak, A. M. Sokolov, and V. I. Shpakov. Pribory i Tekhn. Eksperim., No. 3, 52-4(May-June 1964). (In Russian)

A 4π scintillation counter for measuring the radioactivity of gaseous products is described. The counter enables absolute measurements to be performed on radioactive gases, including chemically reactive gases under pressures to a few atmospheres, and on gas jets. (tr-auth)

43981 SILICON SURFACE-BARRIER ALPHA DETECTORS. A. K. Mednikov and A. A. Babushkin (Inst. of Nuclear Physics, Academy of Sciences, Kazakh SSR). Pribory i Tekhn. Eksperim., No. 3, 55-6(May-June 1964). (In Russian)

The effect of heat treatment on the amplitude spread of surface-barrier silicon alpha detectors is established. The average energy necessary to form electron-hole pairs in silicon is determined to be 4.2 ± 0.2 ev for high-energy particles. (auth)

43982 AMPLITUDE ANALYZER FOR A TRIDIMENSIONAL RECORDING OF NUCLEAR SPECTRA USING NUMERICAL MAGNETIC RECORDING. L. N. Galperin, O. F. Afonin, and I. I. Tkach (Inst. of Physics and Tech., Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 3, 67-77(May-June 1964). (In Russian)

The analyzer allows coincident pulses with different amplitude distributions from two counters to be recorded simultaneously on magnetic tape. The permissible time divergence of the pulses in both circuits is 2 μsec. A digital system is used to record amplitudes by a parallel 6-column double code. The recorder is controlled by visual observation of the spectrum of one circuit. The electrostatic memory tube recorder LN-4 is used for reproduction with the tape. Registration of the recorded-pulse spectrum may be performed with any circuit. Another circuit is used for the selection of slow coincidences with registered pulses, using a diode matrix which selects pulses in a specified amplitude range. The final information is accumulated in the form of a double-ten code in the 63-channel basic register of an electron tube in a doubling electrostatic memory tube and is counted visually. On the remaining track, a blip can be simultaneously recorded for the occurrence of chance coincidences. The recording of pulses corresponding to the blip is carried out in the second register of the electrostatic memory tube and electron tube. (tr-auth)

43983 A SCHEME FOR PULSE PAIR SELECTION. V. D. Spirin and A. S. Burgorkov (Leningrad Scientific Research Inst. of Radiation Hygiene). Pribory i Tekhn. Eksperim., No. 3, 78-9(May-June 1964). (In Russian)

An electronic circuit is described which allows a pair of pulses separated in time by not more than a given interval to be selected from a set of pulses created in the input. The time interval can be set from 0.05 to 0.5 sec. An application of the apparatus permits the measuring of ultrasmall quantities of ^{224}Ra in samples. (tr-auth)

43984 A DESIGN FOR SEPARATING THE AI-100-1 ANALYZER OPERATING RANGE INTO TWO SUBGROUPS OF 50 CHANNELS EACH. Yu. P. Antuf'ev and P. V. Sorokin. Pribory i Tekhn. Eksperim., No. 3, 79-80(May-June 1964). (In Russian)

A simple scheme which allows the AI-100-1 analyzer to be used for simultaneous recording of spectra from two detectors is described. The analyzer operating range is divided into two subgroups of 50 channels each. Full electrical diagrams of the divided apparatus and the mixing amplifier are presented, and spectra from the two detectors, recorded simultaneously by the divided analyzer, are given to illustrate its operation. (tr-auth)

43985 PHOTOELECTRON MULTIPLIER AMPLIFICATION FACTOR COMPENSATIONS DURING SHIFTS IN POWER SUPPLY. Yu. V. Anishchenko and O. F. Ogurtsov. Pribory i Tekhn. Eksperim., No. 3, 136-8(May-June 1964). (In Russian)

Two methods of compensation for photomultiplier amplification factor instability during changes in voltage are considered: 1) automatic regulation of the amplification factor of the amplified cascade using a tube with an elongated anode-grid characteristic; 2) regulation of the threshold by means of superposition of the coupling between the voltage supply and a threshold apparatus. In the latter case, as is verified experimentally, the stabilization factor is 20. For this, one may talk about the plateau of counting characteristics of a scintillation detector. The plateau length is abuut 100 v and the slope less than 0.03%/v for the FEU-44, charged by light scintillations exponentially with the falling spectrum. (tr-auth)

43986 DEPENDENCE OF CsI(Tl) CRYSTAL LUMINESCENCE ON PROTON AND DEUTERON ENERGY. Yu. A. Tsirlin, I. I. Zalyubovskii, T. I. Sokolovskaya, V. G. Neznamov, and R. A. Nikulina (All-Union Scientific Research Inst. of Monocrystals, USSR). Pribory i Tekhn. Eksperim., No. 3, 214(May-June 1964). (In Russian)

The energy dependence of the light yield of CsI(Tl) crystals was studied at 10 to 100 kev. The purpose of the experiment was to determine the usefulness of the crystals as scintillators in charged particle detectors. The energy dependence for both protons and deuterons was found to be almost linear. (auth)

43987 AN EXTRAPOLATION IONIZATION CHAMBER FOR X, GAMMA AND BETA DOSIMETRY. S. Belletti (Spedali Civili, Brescia, Italy) and G. Tornielli. Radiol. Med., 50: 900-13(Sept. 1964). (In Italian)

A perspex extrapolation ionization chamber studied in two versions respectively for dosimetry of beta applicators and dosimetry of beams of x ray, gamma radiation of ^{60}Co and ^{137}Cs, and of accelerated electrons with energies from three to 20 Mev, is presented. The characteristics of the chamber are as follows: distance between electrodes adjustable up to 0.1 mm; surface of the collecting electrode variable in four combinations from 2.86 to 724.5 mm^2. The measuring system consists of an electrometer of 10^{-15} ampere sensitivity and of an integrating circuit for measuring pulsed beams. The chamber has also been studied for taking measurements in atmospheres of gas or mixtures of gas differing from air, with a pressure down to 1 mm of mercury. (auth)

43988 AN ANALYSIS OF ALPHA PARTICLE SPECTRA USING THE "DA" TYPE DEVICE COMBINED WITH AN AIR CHAMBER. B. V. Karasev, Yu. A. Priselkov, and B. G. Pakhomov. Vestn. Mosk. Univ., Ser. II, Khim., No. 6, 47-9(Nov.-Dec. 1963). (In Russian)

Alpha energy spectra were measured using a DA device combined with air chamber. Uranium and plutonium α emitters (120 to 150 mg/cm) on stainless steel were used. Pulse amplitude distributions were determined by two different methods. The plotted curves indicate that both methods were efficient in identifying separate α emitters. The resolution at half-height was 140 to 180 kev. A long duration pulse (to 10^{-2} sec) and low integral load (not more than 300 to 350 pulses/min) are the main disadvantages of the air chamber method. (R.V.J.)

43989 SOME PROBLEMS CONNECTED WITH THE DESIGN OF A DOUBLE PULSE NEUTRON SCINTILLATION COUNTER. Andrzej Lipinski, Marian Przytula, and Aleksander Szymanski (Univ. Lodz, Poland). Zeszyty Nauk. Univ. Lodz. Ser. II, 9: 41-63(1961). (In Polish)

In connection with the design of the fast neutron generator an investigation was made of the fast neutron detection in the presence of gamma ray background. The results of considerations and experiments made in the course of designing a double pulse neutron scintillation counter are presented. The principle of the counter was discussed, and the method of calculating its efficiency was presented. The possibility of applying the counter for the determination of neutron energy was also discussed. Further, a few electric circuits for the counter were proposed. The results of the investigation of boron loaded liquid scintillators were given as well as their efficiencies with the discussion of their usefulness for the counter. (auth)

43990 A GERMANIUM γ-QUANTUM COUNTER WITH RADIATIVE DEFECTS. S. M. Ryvkin, O. A. Matveev, N. B. Strokan, and A. Kh. Khusianov (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 34: 1535-7(Aug. 1964). (In Russian)

In beta and γ spectroscopy, n-i-p structures with extensive sensitivity zones (i) are utilized. Ordinarily the i-zone is formed by compensation acceptors with lithium admixtures producing fine donor levels. However, lithium counters demand special low-temperature storage. Descriptions are given of germanium γ counters with deep level compensation produced by radiation defects. The energy spectra of ^{137}Cs recorded by such counters indicate a resolving power of ~3%, with an energy of pair formation 3.0 ± 0.1 ev. (R.V.J.)

43991 SILICON NEUTRON DETECTORS. E. M. Lobanov, V. I. Zvyagin, and B. P. Zverev. p.59-63 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

If boron is present in a solid-state silicon counter, thermal neutrons can be detected by a $^{10}B(n,\alpha)^7Li$ reaction, in which a 1.47-Mev α particle and a 0.88-Mev ^7Li nucleus are formed. Fast neutrons having energies >0.5 Mev can be detected by counting the recoil nucleus of a light element (in particular, hydrogen) after a neutron collision. A diffused silicon n-p transistor was irradiated with reactor neutrons. The open transistor showed only a few pulses compared to the number of pulses observed when the transistor was covered with a polyethylene film 150 μ thick. With an average energy of 2 Mev assumed for fast reactor neutrons, it was estimated that recoil hydrogen nuclei with an average energy of 1 Mev are obtained by collision of neutrons with hydrogen atoms in the polyethylene. The neutron counting efficiency was 0.1%. The neutron flux attenuation was determined as a function of thickness for paraffin, steel, cast iron, and lead. Thermal neutrons were detected by covering the silicon counter with a filter enriched in ^{10}B. The counting efficiency for thermal neutrons was 1.02%. Thus, surface-barrier transistors can be used to detect either fast neutrons or slow neutrons. (TTT)

43992 NEUTRON CRYSTAL SPECTROMETER FILTER (Engineering Materials). (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). (CAPE-1106)

Drawings (4) are presented for a neutron filter which is a mechanical velocity selector of the Dash-Sommers type with straight slits. It is used with the MTR crystal spectrometer in low energy neutron research. The rotor removes undesirable, higher-order contaminants, thus insur-

ing the production of a truly monochromatic Bragg beam. The rotor is constructed of magnesium and fiberglass-epoxy laminate to minimize weight. It is driven by a $\frac{1}{8}$ hp synchronous motor. The active length of the rotor is 21 in.; the usable beam height is 2 in. Vanes of fiberglass laminate are set into 235 slots milled around the periphery of a 4 in. dia magnesium core. Eight spacer rings of magnesium are slipped over the core and a $\frac{3}{16}$ in. winding of glass filament impregnated with epoxy is applied. The housing case is a $\frac{1}{2}$ in. thick aluminum cylinder. The casing aligns the ends on which the axle stubs are mounted, encloses the rotor in a vacuum, and acts as a safety shield. Rotor speeds of 12,000 rpm and an operating range of 1 ev are anticipated. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

43993 TRANSISTORIZED, REGULATED HIGH-VOLTAGE POWER SUPPLIES /Q-2291A/ (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1132)

Drawings (7) are presented for h-v power supplies that are capable of operating over a wide range of primary supply voltages and a wide range of loads with a regulation factor seldom achieved in precision laboratory supplies. The supplies are used with portable survey units requiring high-voltage supplies delivering moderately high currents with good voltage regulation. The output voltages (500 v, 900 v, 1200 v, and 1400 v) are used with health physics survey instruments. Units are hermetically sealed in $1\frac{19}{32}$ in. $\times$ $1\frac{11}{32}$ in. $\times$ $2\frac{11}{32}$ in. cases which weigh 3.5 oz. They deliver 140 Mw of power with an over-all efficiency of 60 to 70%. Output voltages change less than 0.05% with a change from no load to full load. When loaded to half capacity, the primary supply voltage can be decreased from 12 to 6 v without producing more than a 0.05 change in the output voltage, therefore, they may be powered from either 6- or 12-v primary supplies. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

ISOTOPE TECHNOLOGY

General

43994 PARTICIPATION OF THE LABORATORY FOR METROLOGY OF RADIONUCLIDES, FROM THE INSTITUTE FOR ATOMIC PHYSICS (I.F.A.), IN THE INTERNATIONAL INTERCOMPARISON OF RADIOACTIVITY STANDARDS 1961-1963. I. Asavinei, E. Buriacu, L. Grigorescu, C. Lazarovici, M. Oncescu, and P. Sandru (Inst. for Atomic Physics, Bucharest). Rev. Roumaine Phys., 9: 515-20(1964).

The results obtained at the international intercomparison of radioactive standard solutions are presented. Technical details are given on the methods used by the I.F.A. laboratory for metrology of radionuclides, the corrections made to the obtained values, and the maximum deviation of the results obtained. (auth)

43995 DEVELOPMENT AND UTILIZATION OF RADIOISOTOPES IN JAPAN. [Tokyo], Japan Atomic Industrial Forum, Inc., 1963. 31p.

Historic use and current trends of radioisotope utilization in the fields of physics, chemistry, engineering, radiation chemistry, biology, medicine, pharmacology, and agriculture are discussed. Other aspects of the Japanese radioisotope program presented are: supply; safety from radiation hazards; information exchange; development of measuring instruments; economic advantages; training of technicians and engineers; and plans for future development and use. (H.M.G.)

43996 RADIOISOTOPES AND RADIATION—RECENT ADVANCES IN MEDICINE, AGRICULTURE, AND INDUSTRY. John H. Lawrence (California. Univ., Berkeley. Donner Lab.; California. Univ., Berkeley. Donner Pavilion); Bernard Manowitz (Brookhaven National Lab., Upton, N. Y.); and Benjamin S. Loeb (Division of Technical Information, AEC). New York, McGraw-Hill Book Co., 1964. 140p. $18.00.

Applications of radioisotopes in medical diagnosis and research, therapy, veterinary medicine, animal husbandry, agriculture, food processing, sterilization of medical supplies, studies of the environment, synthesis of chemicals, gaging, and industrial radiography are reviewed. (C.H.)

Industrial Applications

Refer also to abstract 44010.

43997 (EUR-1882.e) APPLICATION OF ATOMIC ENERGY IN AGRICULTURE. Annual Report, 1963. (Netherlands. Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen). 1964. 46p.

Progress is reported on five aspects of the use of atomic energy in agricultural research. Separate abstracts were prepared for each. (H.M.G.)

For abstracts of individual sections see: 43170, 43218, 43929, 43998, and 43999.

43998 (EUR-1882.e(p.1-6)) PROSPECTS IN FOOD IRRADIATION. J. G. van Kooy and D. de Zeeuw (Netherlands. Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen).

Progress in food irradiation studies is reviewed. It is pointed out that food radiopreservation resulting in improved storage stability is considerably more important than food radiosterilization aimed at producing a stable product. Fungus growth retardation, pigment variations, and organoleptic factors in irradiated fruits are discussed. That the composition of the product is important in determining the feasibility of radiopreservation, is evidenced by the fact that products with a high protein and fat content, usually products of animal origin, are more radiosensitive than vegetable ones. The status of the following food irradiation problems is presented: formation of toxic or carcinogenic substances, bacteriological reliability, radioactivity levels, and nutritive value. (H.M.G.)

43999 (EUR-1882.e(p.27-31)) PRESERVATION OF FOOD BY MEANS OF RADIATION. (Netherlands. Instituut voor Toepassing van Atoomenergie in de Landbouw, Wageningen).

Physiological and biochemical studies of soft fruits irradiated with 0.5 to 1.0 Mev electrons showed that the study of immediate physiological irradiation effects is significant only under precise conditions of environment. Apples, pears, soft fruit, and vegetables were used to determine the effectiveness of 1 to 3 Mev electrons in surface pasteurization. It was concluded that the best method for hard fruit irradiation was to roll the products giving doses of about 100 Krad. Strawberries, blackberries, and raspberries gave the most promising results with soft fruits, slightly unripe berries being preferred. Lettuce, cauliflower, and tomatoes were vegetables that appeared suitable for radiopreservation processes, and 3 Mev-electron-irradiated mushrooms were spectacularly improved by the process. No advantage was found with irradiation or celery, swede, or red cabbage. The radiomimetic effects of γ-irradiated glucose were studied in Allium cepa, Hordeum sativum, and Vicia faba and in mice and Drosophila. (H.M.G.)

44000 (JPRS-26803(p.1-3)) THE USE OF ISOTOPES IN THE UKRAINE. M. Gol'din. Translated from At. Energ. (USSR), No. 2, 173-4(1964).

A brief description is given of the uses of radioisotopes in science and technology in the Ukraine. Some of the uses described are: wear resistance in steel, microdistribution of S and P in cast iron, control of production of iron and steel, automatic loading of hoppers, crushing of iron ore, and field assays of ores. (D.L.C.)

44001 ECONOMIC ADVANTAGES OF THE USE OF RADIOISOTOPES IN INDUSTRY. A. J. Verbiest. Atoomenergie Haar Toepassingen, 6: 164-71(Aug. 1964). (In Dutch)

The industrial utilization of radioisotopes can lead to economy of primary materials, increased production, and a saving in the work force. The measurement methods using radioisotopes-density meters, level meters, specific gravity meters, ionization, gas chromatography, and radiotracers—are indicated. The industries using radioisotopes in their manufacturing processes are described. (tr-auth)

44002 RADIATION PRESERVATION OF MARINE PRODUCTS: U.S.A.E.C. PROGRAMME. E. Machureck (Atomic Energy Commission, Washington, D. C.). Food Irradiation, 4: No. 4, A2-7(Apr.-June 1964).

Work of the USAEC on the radiopasteurization of marine

products is reviewed. Irradiation facilities of the USAEC are discussed with emphasis on the design of the Marine Products Development Irradiator. Plans for an on-board ship irradiator are considered. Economic feasibility and acceptance tests conducted as a part of the program are summarized. (H.M.G.)

44003 PASTEURIZATION OF FISH BY IONIZING RADIATION. A STUDY OF FEASIBILITY IN THE UNITED KINGDOM. D. N. Rhodes (Agricultural Research Council, Cambridge, Eng.). Food Irradiation, 4: No. 4, A8-22(Apr.-June 1964).

It was established on the experimental scale that packaged and irradiated fillets from four day old fish will remain in first class condition for between 10 and 20 days under the conditions likely to be obtained in commercial practice. Such an extended storage life for fish could be utilized in Britain to produce a much better article at the time of purchase by the consumer, especially at the inland centers of population. Such a process is likely to prove profitable to the fish trade because preparation and treatment would be centralised at the port of landing, and distribution arrangements could be made more efficient. The retailing of fish would be greatly affected by the introduction of clean and attractive packaging at standard weights, and sales promotion could be built up around a branded product. These factors combine in the concept of the irradiated article as presenting a new standard of quality in fish to the majority of consumers. The maintenance of this standard, identified with the producing company by its brand name, and the realization of the maximum storage life and hence convenience in distribution, would depend largely upon the careful control of temperature of storage as near to 0°C (32°F) as possible. This, in turn, would eliminate risk from the imponderable hazard from spores of Clostridium botulinum which might be present in fish. (auth)

44004 WORLD-WIDE DEVELOPMENTS IN ISOTOPES, RADIATION, AND NUCLEAR EXPLOSIVES. V. P. Guinn. Nucl. News, 7: No. 10, 47-9(Oct. 1964).

A summary is given of the Geneva Conference papers on the applications of atomic energy, radiation chemistry, radiation processing, activation analysis, and applications of isotopes and radiation sources in the physical and life sciences. (C.E.S.)

44005 PRESERVATION AND STERILIZATION OF FOOD BY IONIZING RADIATION. Abdur Rahman. Nucleus (Lahore), 1: 21-4(Jan.-Mar. 1964).

The status of radiopreservation and radiosterilization of food is reviewed with respect to: types of radiations, interactions of radiations and organisms; mechanisms of radiopreservation; and sources of radiation for food preservation. (H.M.G.)

44006 RADIATSIONNAYA AVTOMATIKA, IZOTOPY I YADERNYE IZLUCHENIYA V NAUKE I TEKHNIKE. (Radiation Automation, Isotopes, and Nuclear Emissions Science and Technology). V. I. Stechenko. Kiev, Publishing House of the Ukrainian Academy of Sciences, 1964. 193p.

Thirty papers are included on the applications of radioisotopes and radiations in science and technology. The data were originally presented at the Conference on the Utilization of Nuclear Energy, Kiev, March 1961. Papers are arranged in three groups: applications of radioisotopes and radiations in control and automation devices for various technological processes, properties of metals and chemical and electrolytic coatings, and metal diffusion and self-diffusion studies using isotopes. (R.V.J.)

Power Application

44007 USE OF RADIOISOTOPES AS ENERGY SOURCES. Miguel Bernat. Ciencia Tec. (Buenos Aires), 133: 1-13(Jan.-Feb. 1964). (In Spanish)

In the concluding section of the discussion of the use of radioisotopes as energy sources, the nuclear reactions used to produce radioisotopes are indicated. Power generators using radioactive sources are briefly described. (J.S.R.)

44008 POLONIUM COMPOUND HEAT SOURCES. Martin R. Hertz (to U. S. Atomic Energy Commission). U. S. Patent 3,154,501. Oct. 27, 1964.

Improved radioactive materials were developed for use in heat sources. ^{210}Po was reacted with rare earth elements such as scandium, yttrium, or the lanthanide series to form radioactive compounds or materials of lower vapor pressures and higher melting points than ^{210}Po itself. (AEC)

Separation and Production

44009 (NP-14369) CONSTRUCCIÓN DE UN SEPARADOR ELECTROMAGNÉTICO DE ISÓTOPOS. Informe No. 113. (Construction of an Electromagnetic Isotope Separator. Report No. 113). Moises J. Sametband (Argentina. Comisión Nacional de Energía Atómica, Buenos Aires). 1964. 31p.

The electromagnetic isotope separator built at the Comisión Nacional de Energía Atómica is of the 180° type, with a radius of curvature of 100 cm and a gap width of 17 cm. The magnetic field, stabilized in 1: 10,000, ranges from 300 to 4300 gauss, and the pole pieces are corrected to give a good focusing for an ion beam which diverges up to 30°. The profile of the pole pieces was designed after a series of measurements using a model magnet and an analogic method, so obtaining a discrepancy of not more than 0.5% with respect to the theoretical field. The ion source is of the hot filament type, and a furnace enables to vaporize almost all elements. The accelerating system was designed with the aid of an analogic method which simulates the space charge of an intense ion beam. Gaseous elements have been initially separated; a program of separation of zinc and other stable and radioactive elements is already in development. (auth)

44010 FABRICATION AND USE OF ARTIFICIAL RADIOELEMENTS. Charlie Fisher (Commissariat a l'Energie Atomique, Paris). Ind. At., 8: No. 7-8, 87-94(1964). (In French)

Although production of radioelements in significant quantities began some fifteen years ago, it is still forging ahead. The same is true for the various applications, particularly industrial, of these products. A recent inquiry showed that these applications enabled French industry to effectuate savings of 40 million francs in 1961. Developing fields which show greatest promise are: hydrology, displacement of sediments, analysis by activation, x-ray fluorescence, and the use of intense radiation sources. (auth)

44011 A TECHNOLOGICAL MONUMENT: PLANT FOR SEPARATION OF U-235 AT PIERRELATTE. Yves Mériel. Nature (Paris), No. 3351, 255-8(July 1964). (In French)

The Pierrelatte plant for the separation of ^{235}U by gaseous diffusion is one of the great technological achievements of France. The principles of the separation of U isotopes are briefly summarized. The major problem areas with

respect to UF_6 are maintenance of the temperature above 57°C, corrosive behavior of the gas, and its reactivity with all substances containing hydrogen. The enrichments in ^{235}U attainable at the plant are discussed. (J.S.R.)

44012 ISOTOPE SEPARATION BY CONCURRENT GAS CENTRIFUGE. II. SEPARATIVE POWER OF THREE CONCURRENT STREAMS. Akira Kanagawa and Yoichi Takashima (Tokyo Inst. of Tech.). Nippon Genshiryoku Gakkaishi, 6: 511-16(Sept. 1964). (In Japanese)

The separation performance was studied on a concurrent gas centrifuge with three thin streams. The radii of stream paths, the gas flow rates, and the cuts are the important factors for evaluation of the separative power. The calculated results showed that there existed some proper gas flow rate to get the maximum separative power for any set of radii and cuts, and further the optimum set of radii and cuts under which condition the separative power could become largest was found. The case in which the inner two thin streams were mixed at the exit was also analyzed. As a result, it was confirmed that it was possible to obtain the larger separative power even in the latter case than that in the case of two thin streams. Therefore, it is suggested that the proper thickness of stream path may be rather favorable for the performance of separation. (auth)

44013 A SIMPLE ELECTRIC MODEL OF THE ISOTOPE ENRICHMENT PROCESS IN A DISTILLATION COLUMN. Anatol Selecki and Jan Bulanda (Inst. for Nuclear Research, Warsaw). Przemysl Chem., 43: 438-40 (Aug. 1964). (In Polish)

The possibility of representing the kinetics of the process of oxygen ^{18}O enrichment in a distillation column, by using a simple electric model, based on R-C quadripoles, was examined. A satisfactory work accuracy (±3%) of this model, which gives the possibility of step type regulation of two process parameters, was found. The model may be a starting point to the automatic control of isotope distillation columns. (auth)

44014 PRODUCTION OF DEUTERIUM AND HEAVY WATER BY ISOTOPIC EXCHANGE. Yves Meriel. Sci. Progr.–Nature, No. 3352, 305-10(Aug. 1964). (In French)

A procedure for the production of heavy water, using a preconcentration based on the reaction between ammonia and water, is reported. The reaction has a high isotopic exchange constant between the two reactants. The characteristics of the ammonia–hydrogen reaction are discussed; its use in the production of heavy water is described. A bithermal step, in which the ammonia or hydrogen reacts with water, is indicated. (J.S.R.)

44015 CONTINUOUS SEPARATION OF POLYNARY ISOTOPE MIXTURES BY THERMIC DIFFUSION IN THE CLUSIUS-DICKEL-SEPARATING TUBE. G. Mueller (Deutsche Akademie, Wissenschaften, Berlin and Leipzig). Z. Chem., 3: 478(1963). (In German)

The differential equation system expressing the final concentration of all components of a polynary isotope mixture that is in a stationary state at the end of a cylindrical separation tube is given. The study of the continuous separation of argon isotopes shows a satisfactory agreement between measured and theoretical values for the concentrations of ^{36}Ar and ^{38}Ar. The equation expressing the maximum attainable concentration of a mean component is also given. (J.S.R.)

44016 SEPARATION OF LITHIUM ISOTOPES IN AQUEOUS LiCl SOLUTIONS. B. P. Konstantinov and V. B. Fiks (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Fiz. Khim., 38: 1904-8(Aug. 1964). (In Russian)

The results of experiments on the separation of ^{6}Li and ^{7}Li isotopes in aqueous LiCl solutions of concentrations from 1 to 9 N are described. The efficiency of partition columns was determined by direct measurement of the equivalent diffusion coefficients. (auth)

MATHEMATICS AND COMPUTERS

Refer also to abstracts 43151, 44431, and 44976.

44017 (BNL-7332) COMPUTERS AND DATA TAKING. R. J. Spinrad (Brookhaven National Lab., Upton, N. Y.). [1963]. Contract AT-30-2-GEN-16. 19p.

The use of small stored-program digital computers, with their magnetic core random access memories, is compared to fixed-program analyzers used in multiparameter analyses. Some advantages are cited. (R.E.U.)

44018 (ISS-64/6) METODI DI ANALISI DI UNA CURVA DI DISTRIBUZIONE SPERIMENTALE IN GAUSSIANE. (Some Methods of Analysis of an Experimental Distribution Curve in Overlapping Gaussians). C. Frontali (Italy. Istituto Superiore di Sanita, Rome). Mar. 12, 1964. 27p.

An experimental distribution curve often results from the superposition of two or more gaussian components. The determination of the parameters characterizing each component, so as to give the best fit to the experimental curve, is a difficult mathematical problem, even when a definite hypothesis is made concerning their number. Some analytical and graphical methods of analysis are described, and their degree of approximation discussed. (auth)

44019 (K-DP-364) STOP—A STRUCTURED OPERAND PACKAGE FOR FORTRAN. H. Katzan, Jr. (Oak Ridge Gaseous Diffusion Plant, Tenn.). Sept. 1964. Contract W-7405-eng-26. 42p. (CONF-746-1)

From Association for Computing Machinery Regional Meeting, Atlanta, Oct. 1964.

A set of FORTRAN subroutines useful for the processing of structured operands such as vectors and matrices is given. The elements of the operands may be either 7090 floating point words (REAL variables), packed BCD characters, or logical variables. (auth)

44020 (LA-3132-MS(p.180-1)) DATA ANALYSIS BY COMPUTER. P. N. Dean (Los Alamos Scientific Lab., N. Mex.).

The application of computer techniques to the analysis of radiobiological data was continued. The RTW (Retention, Elapsed Time, and Weighting Factor) series of computer codes was updated so that the input, output, and method of handling are the same for all 4 codes: RTW-1, RTW-1A, RT RTW-2, and RTW-2A. A computer program was designed for the complete analysis of ultracentrifugal ultraviolet sedimentation boundaries. This Boundary Diagnostic Program (BODPRO) is completely general and is applicable to any sedimentable substance which can produce an ultraviolet boundary in the ultracentrifuge. A computer program was written for calculating molecular weights from data obtained by equilibrium sedimentation in a density gradient. In the field of complex gamma spectra analysis, it is often useful to compare idealized spectra with experimental ones. A computer code (MIX) was written to add standard spectra in any proportions and to plot the sum spectrum. Two such additions can be plotted on the same film, giving a direct comparison of experimental and theoretical data. The technique of complex gamma spectrum analysis was applied to spectrophotometric analysis of mixtures of the bases guanine, thymine, cytosine, uracil, and adenine. The method used is to compare the ultraviolet absorption spectra of the various bases, treating them as pulse height spectra with the computer code IQ. The results were not completely satisfactory and the experiment will be repeated. (auth)

44021 (NAA-SR-Memo-10008) MALINDA—MANIPULATION AND LISTING OF NUCLEAR DATA. D. W. Roeder (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). June 1964. Contract AT-11-1-GEN-8. 139p.

MALINDA is a FORTRAN II program for IBM 7090/7094, which handles nuclear cross section data from the Master Nuclear Data File at Atomics International and other sources and prepares such data for the nuclear codes PRISM and TYCHE. Among its chief features are: (1) optional formats for cross section input to MALINDA; (2) interpolation of input cross sections to a different energy grid; (3) comparison of cross sections from different sources on CRT output; (4) two different arrangements of decimal punched card output for subsequent use in MALINDA; (5) binary punched card output for use in PRISM and TYCHE; (6) special listings of cross sections for use in reports; and (7) summation of partial level data to obtain total inelastic scattering cross section. The program is filed as deck number 3W861 at Department 792, Atomics International. (auth)

44022 (RM-3942-PR) INTEGRAL EQUATIONS WITH DIFFERENCE KERNELS ON FINITE INTERVALS. A. Leonard and T. Mullikin (RAND Corp., Santa Monica, Calif.). June 1964. Contract AF49-(638)-700. 19p. (AD-601125)

A technique for the solution of certain integral equations, on a finite interval of the real line, that arise in the theories of neutron transport, radiative transfer, gas dynamics, and electromagnetic wave refraction is presented. The kernels in the equations studied are functions of the difference of the arguments and involve an exponential factor. Existence, uniqueness, and computational aspects are considered. (auth)

44023 (UCRL-11458) AN ON-LINE COMPUTER INSTALLATION AT LAWRENCE RADIATION LABORATORY, BERKELEY. Lloyd B. Robinson and Fred S. Goulding (California. Univ., Berkeley. Lawrence Radiation Lab.). July 9, 1964. Contract W-7405-eng-48. 9p. (CONF-593-5)

From Conference on the Automatic Acquisition and Reduction of Nuclear Data, Karlsruhe, Ger., July 1964.

The PDP-5 (8k) installation at the 88-inch cyclotron, which provides for rapid transfer of information from a 4096-channel pulse-height analyzer, is discussed. Simple calculations will be carried out on the data, using a CRT display and a "light pen" for easy operator intervention. The computer provides for program interruption by external devices, so that it will be possible to interlace a number of operations. A method was devised to allow efficient use of the 12-bit words of the computer in pulse-height analysis applications, where a few channels may contain many more counts than a 12-bit word could hold. The technique will also allow use of the computer as a de-randomizer in high-speed pulse-height analysis. (auth)

44024 (WAPD-T-1685) CONTACT CORROSION. J. M. Marsh and V. P. Scott (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Mar. 1964. Contract AT-11-1-GEN-14. 27p. (CONF-745-1)

From Midwestern Simulation Council, Urbana, Ill., Mar. 1964.

The problem of atmospheric corrosion of electrical contacts in an analog computer is discussed. A study was made of the patch cord problem, and the attack was determined as being due to hydrogen sulfide. Attempts were made to salvage existing patch cords and patch bay springs, and to eliminate hydrogen sulfide. Attenuator switches were also studied. (D.L.C.)

44025 (WAPD-T-1701) ANALOG FACILITY GROUNDING TECHNIQUES. J. M. Marsh and V. P. Scott (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). June 30, 1964. Contract AT-11-1-GEN-14. 21p. (CONF-751-1)

From Joint Eastern and Western Simulation Council Meeting, Pittsburgh, Pa., June 1964.

The design and installation of the ground plane system for the Bettis Analog Laboratory are described. (R.E.U.)

44026 APPLICATION OF REGRESSION ANALYSIS TO THE POWER FUNCTION. P. C. McWilliams, J. E. Furchner, and C. R. Richmond (Los Alamos Scientific Lab., N. Mex.). Health Phys., 10: 817-22(Nov. 1964). (LADC-6142)

With electronic computers to do the labor, it is possible to perform regression analyses on power and exponential functions without recourse to logarithmic transformations. It is emphasized that fitting a function of the form, $Y = aX^b$, to experimental data may give results quite different from those obtained by fitting a function of the form, $\log Y = \log a + b \log X$, to logarithms of the same data. (auth)

44027 AN INTEGRAL EQUATION FOR THE ASSOCIATED LEGENDRE FUNCTION OF THE FIRST KIND. Attia A. Ashour (High Altitude Observatory, Boulder, Colo.). J. Math. Phys. (N. Y.), 5: 1421-3(Oct. 1964).

The solution of the Fredholm homogeneous equation $\psi(\xi) = \lambda \int_0^1 M(\xi,\xi')\psi(\xi')d\xi'$, where $M(\xi,\xi') = \int_0^\pi [\cos m\phi \, d\phi/(x^2 - 2xx' \cos\phi + x'^2)^{\frac{1}{2}}]$ and $x = (1-\xi^2)^{\frac{1}{2}}$ is found to be the associated Legendre function $P_n^m(\xi)$, n + m even; and the characteristic numbers of this kernel are obtained. The solution of the corresponding equation of the second kind is also found. The kernel of the homogeneous equation, the solution of which is $P_n^m(\xi)$, n + m odd, is obtained. (auth)

44028 N-DIMENSIONAL TOTAL ORBITAL ANGULAR-MOMENTUM OPERATOR. II. EXPLICIT REPRESENTATIONS. Kenneth D. Granzow (Sandia Lab., Albuquerque, N. Mex.). J. Math. Phys. (N. Y.), 5: 1474-7(Oct. 1964).

A method of generating orthogonal polar coordinate systems in N-dimensional space is presented. Commuting angular-momentum operators are easily found in the coordinate systems generated; these operators are of a single form which depends on two parameters. A short table of coordinate systems and the resulting structure of quantum numbers and eigenfunctions is included. (auth)

METALS, CERAMICS, AND OTHER MATERIALS

General

Refer also to abstracts 43365, 44925, 44926, 44927, 44928, 45020, and 45024.

44029 (AD-600126) PRODUCTION ENGINEERING MEASURE FOR BERYLLIUM OXIDE AND PARTS PRODUCED FROM IMPORTED ORES. Quarterly Progress Report No. 2, October 1–December 31, 1963. J. F. Blum and W. R. Raymont (Beryllium Corp., Reading, Penna.). Contract DA-36-039-AMC-01481(E). 37p.

Physical property measurements were completed on beryllium oxide parts produced from standard powder and fabrication processes. Average test values are as follows: dielectric constant and loss factor –6.43 and 0.00089 respectively at 23°C, dielectric strength –209 volts/mil at room temperature, flexural strength –26,000 psi at room temperature, thermal conductivity –1516 Btu × in./hr. × sq ft × °F at 100°F and 1056 Btu × in./hr × sq ft × °F at 280°F. Four typical beryllium oxide parts for use in the electronics industry were produced to required specifications. (auth)

44030 (ANL-6800(p.297-304)) HIGH-TEMPERATURE FUELS AND MATERIALS DEVELOPMENT. R. K. Edwards (Argonne National Lab., Ill.).

A program for the development of high temperature fuels and materials is under way. The general area of study is concerned with the chemical stability and chemical reactions of potential high-temperature fuels (such as uranium oxides, phosphides, sulfides, arsenides, nitrides, and possible solid solutions) with possible reactor environments (H_2 and contaminating gases) and with supporting refractory components (such as W, Re, Mo, Ta, and certain alloys). The objective is to build up a reservoir of basic data from which needed information for evaluation studies may be drawn. The approach is to study the relevant chemical systems in a quantitative manner leading to thermodynamic evaluations. Selected systems are to be investigated in an integrated way using primary methods of high temperature study which are mutually supporting such as effusion vapor pressure measurements, mass spectrometric measurements of effusing species, transpiration vapor pressure measurements, phase diagram measurements, and interdiffusion measurements. Definition of the experimentation was initiated during this report period and the main efforts were devoted to the planning, acquisition, installation, and adaptation of equipment for the projected measurements. Studies of the vapor-condensed state equilibria in the U–UO_2 system are in progress. Exploratory studies of the nature of the condensed state phase diagrams of US with several of the refractory metals were carried out. A time-of-flight mass spectrometer with provision for high temperature effusion studies is nearly operational. (auth)

44031 (BM-RI-6536) EFFECT OF IMPURITY LEVELS ON ZIRCALOY 2 MICROSTRUCTURE, MECHANICAL PROPERTIES, AND CORROSION RATES. H. Kato, D. J. Stoops, and M. D. Carver (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Dec. 1963. 22p.

The effects of impurity elements silicon, aluminum, copper, nitrogen, and manganese, at 50 to 300 ppm, on the properties of the zirconium alloy Zircaloy-2 were investigated. Variations in microstructure, mechanical properties, and corrosion behavior in some inorganic acid and salt solutions were observed with variations in level of impurity element. Corrodents were solutions of sulfuric acid, phosphoric acid, copper chloride, and iron chloride. Silicon was found to modify annealed microstructures by spheroidizing and dispersion of second-phase material throughout grains. Silicon or manganese improved ultimate and yield strength of the alloy without loss in ductility. All five elements affected corrosion rates of the alloy, the effect being generally different for each element. (auth)

44032 (BMI-1693) SYNTHESIS, FABRICATION, AND CHEMICAL REACTIVITY OF PLUTONIUM MONONITRIDE. William M. Pardue, Victor W. Storhok, Roy A. Smith, Paul H. Bonnell, John E. Gates, and Donald L. Keller (Battelle Memorial Inst., Columbus, Ohio). Sept. 15, 1964. Contract W-7405-eng-92. 41p.

Synthesis of PuN using a hydride-nitride cycle was found to be the most suitable preparation technique. Dense PuN specimens were fabricated by an isostatic hot-pressing technique in which consolidated powder sealed in a refractory-metal container was subjected to 10,000-psi external gas pressure at 1370 to 1540°C for 3 hr. Density and microhardness increased with increased isostatic hot-pressing temperature. Minus 80-mesh PuN powder was completely converted to oxide in 1 to 3 days in air, and increased in oxygen content from 4,700 ppm to 2.252 wt % when stored in a nitrogen-1 per cent oxygen glove-box atmosphere for 30 days (both tests conducted at room temperature). Attack of PuN by the common acids decreased in the sequence HNO_3, HCl, H_3PO_4, H_2SO_4, and HF. PuN appeared compatible with sodium and lithium at temperatures up to at least 800°C but was disintegrated by these metals in the 950 to 1000°C temperature range. PuN was compatible with iron-base alloys, Inconel, and refractory metals at temperatures of 1300°C. (auth)

44033 (GEAP-4633) INCOLOY-800 FOR NUCLEAR FUEL SHEATHS. A MONOGRAPH. C. N. Spalaris, comp. (General Electric Co. Vallecitos Atomic Lab., San Jose, Calif.). July 1964. Contract AT(04-3)-189. 125p.

Incoloy-800 (ASTM designation: Nickel-Iron-Chromium Alloy) has been selected as the reference design alloy for fuel clad applications in nuclear steam superheating reactors. The selection was based upon its superior performance to date over a number of 300-series stainless steel grades in reactor and laboratory experiments. The alloy composition for Incoloy-800 is such as to permit consideration of its use in thermal spectrum reactors where high-temperature service is required, and where possibility of stress-corrosion attack has ruled out the use of type-304 stainless steel. The satisfactory behavior of Incoloy-800 in nuclear superheat environment (up to approximately 4000 hours thus far) prompted testing of this alloy as a backup fuel clad alloy for boiling water reactors where Zircaloy-2 is the reference design clad. Pertinent experimental data regarding the use of Incoloy-800 in fuel designs were collected. The information presented includes Incoloy-800 mechanical prop-

erties, physical metallurgy, metallography and electron microscopy techniques, radiation damage, strain cycle fatigue, corrosion, and irradiation results of fuel elements (clad with Incoloy-800) exposed in superheat environment. (auth)

44034 (HW-82651) METALLURGY RESEARCH OPERATION. Quarterly Progress Report, April–June 1964. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 15, 1964. Contract AT(45-1)-1350. 165p.

The research results are presented in four sections. Separate abstracts were prepared for each section. (J.R.D.)

For abstracts of individual sections see: 44035, 44036, 44037, and 44038.

44035 (HW-82651(p.3.1-59)) PHYSICAL METALLURGY. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Electron microscopy studies revealed channels in Mo single crystals irradiated to 10^{19} nvt and subsequently strained, but not in crystals irradiated to only 18 nvt. Analysis of the channel traces on the (110) planes indicated that cross slip occurred. A slip line study of an irradiated single crystal loaded in bending confirms that multiple slip on closely spaced planes causes channels. Examination of an irradiated (10^{19} nvt) high-purity Cu crystal showed that channeling occurs in face-centered cubic structures (Cu) as well as body-centered cubic structures (Mo). The accuracy of an x-ray technique for obtaining lattice parameters from single crystals was confirmed to be ±0.001%. This measurement technique yielded lattice parameter values of $a_0 = 2.7604$ Å and $c_0 = 4.4599$ Å for a single crystal of Re. A modified version of this technique gave average values of $a_0 = 2.7599$ Å and $c_0 = 4.4585$ Å for a polycrystalline Re foil. Two irradiation capsules, one containing high-purity U specimens operating in the beta phase region (700°C) and the other containing enriched U specimens operating at 400°C, were discharged. Testing of the high pressure prototype irradiation swelling capsule was completed and a modified in-reactor capsule was built. Examination was completed of specimens with various alloying additions. The operating temperature of the specimens was ~575°C and the exposure was 0.11 at. % burnup. The U + Fe – Al alloy specimens showed superior behavior to the U + Fe – Si alloy specimens which in turn showed superior behavior to the high-purity dingot U specimens. A gamma anneal prior to the beta quench improved the behavior of both alloys. Improvements in swelling behavior are related to the decreases of microtearing developed at twin-matrix interfaces. Swelling data from high-purity U specimens of three different enrichments are also reported. A quantitative metallography technique was applied to a U + Fe – Si alloy subjected to various solution and precipitation heat treatments. Alpha range solution heat prior to the precipitation treatment was inadequate while the beta solution treatment was effective in improving the as-received density of finely divided particles. Three numerical methods of analyzing the data from one sample were compared and differences in the resulting distribution are presented. Steady-state creep tests on the six allotropes of Pu were completed and analysis of data is in progress. Activation energies and parameters in a material model proposed by Sherby were evaluated. Anomalies in the creep of the beta phase formed by transformation from the gamma as opposed to transformation from the alpha are presented. Vacuum cathodic and alternating current electrolytic etching techniques were applied to alpha Pu; these techniques show promise in the area of bright field optical and replica electron metallography. The kinetics of the $\beta \rightarrow \alpha$ transformation in electrorefined metal were investigated at –196°C; no physical damage was observed after nine transformation cycles. Absorption of diffracted x rays in Pu is established to be so great as to limit texture information from a single surface. Castings and rolled specimens of electrorefined material were made for the pole figure studies. Aging of castings appears to be detrimental to rolling. Diffraction patterns are presented for alpha Pu produced by transformation from the beta under pressure. (auth)

44036 (HW-82651(p.4.1-49)) REACTOR METALS RESEARCH. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Corrosion and oxidation tests were performed on Ni-base alloys in water vapor and deoxygenated steam at 1200 to 1900°F. Hastelloy R-235, Inconel 702, and Hastelloy N exhibited substantial weight losses in 1200°F steam after 1680 hours. All other alloys showed weight gains, and in this group, those showing superior corrosion resistance were Hastelloy X-280, Inconel 600, Incoloy 800, and Inconel 718. Hastelloy N exhibited best overall performance when exposed to the water vapor environment tests. Severe intergranular penetration at each temperature was found in Incoloy 800, Inconel 702, and Hastelloy R-235. Evaluation of the effects of irradiation on the mechanical properties of a variety of Ni-base alloys is continuing. The results of room temperature tests on specimens irradiated at several temperatures are given. Two in-reactor creep tests on 304 AISI SS are in progress at 500°C and stresses of 20,000 and 30,000 psi. The test at 20,000 psi is showing a creep rate below the minimum resolvable rate of 2.5×10^{-7}/hr. Out-of-reactor data at this temperature and stress is not yet available due to premature failure. The in-reactor test at 30,000 psi stress and 500°C showed a lower creep rate than the out-of-reactor test but a valid comparison cannot be made until another out-of-reactor test is started which will give the same temperature pulse as that observed in-reactor. Results of an in-reactor test at 30,000 psi and 550°C showed no significant difference after 600 hr from those obtained in a out-of-reactor test. To test the hypothesis that high temperature irradiation of Hastelloy X-280 in the solution-treated condition causes carbides to precipitate at irradiation damage sites within the matrix, specimens were solution-treated, cold-worked 26%, and then aged. Room temperature tensile tests showed increased strength and reduced ductility relative to controls. Micrographs show that heavy precipitation occurred along the strain lines of the cold-worked specimens and that grain boundary carbide precipitation was reduced. Room tensile tests on Inconel X-750 in three heat treatments were made. Two double-age treatments differing in environment, cooling rate, and solution treatments showed significantly different properties, particularly in ductility. Micrographs indicate that both grain size and grain boundary carbide distribution differ in the two treatments. The empirical relationship between strain rate and effective stress proposed in the last Quarterly Report was modified. Analysis, based on this modified relationship, of a stress relaxation experiment yielded a theoretical expression which could be fitted to the experimental data by computer methods. Examples of the usefulness of the stress relaxation test are given. These afford insight into work hardening in

body-centered cubic metals and in interpreting the strain rate sensitivity parameter. Derivation of equations unifying the concepts of dislocation dynamics and thermally activated flow are given. Discussion of dislocation multiplication effects is given and evidence that dislocation density change occurs during stress relaxation and strain rate change tests is presented. It is concluded that provisions in the theory should be made for changes in density of mobile dislocations if good agreement with experimental results is to be expected. (auth)

44037 (HW-82651(p.5.1-33)) CHEMICAL METALLURGY. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

Additional data are presented on Zircaloy-2 corrosion confirming accelerated rates with normal fractional pickup of corrosion product H_2 in the ETR G-7 540°F water loop. Details of a scheduled two-cycle experiment in the G-7 Loop are described, in which the effects of H_2 addition to the loop water on Zr alloy corrosion will be determined. Oxidation rates were determined for Haynes Alloy 25 in 100 torr O_2 pressure at 2050°F. Rates were less by a factor of 13 than at 2192°F. In a vacuum of 10^{-4} torr, evaporation rates for Haynes Alloy 25 at 2050°F were one-third those at 2192°F. Additional sensitivity in the chromatographic analysis of impurities in He gas was achieved by optimizing column length and substitution of Linde 13X molecular sieve for the 5A grade. Calibration gas mixtures were prepared in the new gas mixing facility. Extrapolation of peak heights obtained from three standard mixtures down to a value twice the instrument noise level, indicates detection limits for all gases (H_2, O_2, N_2, CH_4, CO, CO_2) of less than 1 ppm. Oxidation studies of Mo and the Mo alloy TZM in 1832°F O_2 at 5×10^{-3} and 5×10^{-4} mm pressure are reported. Weight change data for the oxidized specimens are supplemented by direct measurement of metal loss based on an oxide stripping procedure. Oxidation rates are markedly reduced at the lower O_2 pressures, where formation of the volatile MoO_3 from MoO_2 is slower. The thickness of oxide film on a discharged PRTR process tube was determined metallographically for both irradiated portions and the unirradiated downstream end. Rates of film growth in-core appear to be about a factor of 5 greater than for the out-of-core sample. Corrosion of the tube interior exposed to hot D_2O and the tube exterior in a moist He environment is similar. Results of H_2 analysis qualitatively indicate higher pickup for the irradiated portions of the tube. Evidence pointing to the mechanical nature of film breakdown on corroding Zr alloys was obtained from two experiments. In one test thermal cycling was shown to precipitate rate transition at much lower weight gains than for a duplicate uncycled sample. In the second experiment premature breakaway was induced by mechanically flexing a sample over a cylindrical mandrel, then bending it back to shape. Subsequent weight gains of flexed samples were not affected unless a critical thickness of film was present. The more important corrosion and hydriding characteristics of Zr alloys are reviewed and interpreted in terms of the observed oxide properties. As the oxide thickness increases with time, associated progressive changes in oxide composition gradient occur which regulate transport processes through the oxide. Equilibrium and kinetic studies of the Zr–H system were undertaken to determine the feasibility of using a ZrH moderator of variable H_2 content as a means of reactor control. H_2 absorption and desorption curves were determined at 1385°F in the composition range $ZrH_{0.28}$ to $ZrH_{1.63}$. Isotherms and phase relationships are compared with available published work. Since absorption and desorption processes approached 90% of equilibrium values in a matter of a few minutes, the variable composition hydride moderator appears to have promise. The investigation of velocity effects on Al corrosion in Columbia River water by the spinning disc technique was directed to the synergistic effects of Cu and chloride ion on pit initiation. The effects of pH in the range 3.2 to 7.8 on pit formation and metal loss were examined. (auth)

44038 (HW-82651(p.6.1-8)) MATERIALS ENGINEERING. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

During this quarter 32 inspections were made in 29 process channels. New inspection probes were installed and employed in the inspections of the last 15 process channels. PRTR Zircaloy-2 pressure tube testing included two room temperature burst tests of irradiated specimens, two room temperature crack propagation tests of unirradiated specimens, and an eddy current examination of a flaw in an irradiated tube. Post burst test examination is not complete. Burst strengths were 108,600 psi and 124,000 psi for an annealed and a cold-worked specimen, respectively. Cold-worked and annealed unirradiated specimens had identical Lame hoop stress at crack propagation which, macroscopically, appeared brittle in both cases. Each specimen had a 0.38 in.-long crack. The flaw location in one irradiated tube and the probable upper limit of its size was determined with the eddy current equipment. Slot type brittle fracture tests on N Reactor Zircaloy-2 pressure tubing showed that increasing levels of hydride concentration cause an increasing sensitivity to large defects. At room temperature and reactor operating pressure the crack length for instability in as-received tubing is greater than 20 in. This is reduced to 6 in. at 275 ppm H_2. Initial tests on irradiated KER process tubing indicate little or no effect of irradiation on susceptibility to brittle fracture. The Irradiated Tube Testing Facility operated during the past quarter and seven tube sections were burst tested. Tests on the furnaces produced good temperature uniformity over the length of the test piece. (auth)

44039 (HW-82774) ' THE NONDESTRUCTIVE TESTING OF THE ZIRCALOY-2 TUBES FOR K REACTORS. A. W. Fraser (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Apr. 1964. Contract AT(45-1)-1350. 23p.

The tests carried out on the Zircaloy-2 tubes included ring gage passage, minimum inside diameter, eccentricity, bowing, surface examination, wall thickness, and fluorescent penetrant tests. Of the 5,164 tubes tested, 5,077 were found to be acceptable for reactor installation. A description is given of the tests, equipment, and allied services together with the test results. (D.L.C.)

44040 (MAB-199-M(2)) SECOND PROGRESS REPORT BY THE COMMITTEE ON BERYLLIUM METALLURGY OF THE MATERIALS ADVISORY BOARD. (National Research Council. Materials Advisory Board). Aug. 27, 1964. 79p.

The presentations by jet engine producers concerning the uses and limitations of Be in jet engines and airframes are summarized. Other presentations on Be toxicity and brittleness are also summarized. Subcommittee reports on analysis, test methods, and purification are included. (J.R.D.)

44041 (MATT-293) APPLICATIONS OF STRESS ANALYSIS FOR THE DESIGN OF CERAMIC SEALS. R. Mark and G. Lewin (Princeton Univ., N. J. Plasma Physics Lab.). Aug. 1964. Contract AT(30-1)-1238. 24p. (CONF-716-1)

From American Ceramic Society, Philadelphia, Sept. 1964.

Stress analysis of typical ceramic to glass or metal seals such as the butt seal and the washer-sandwich seal is presented. In addition to theoretical investigation, examples are given of experimental analyses: the application of strain gages to a ceramic prototype and the use of three dimensional photo-elastic model analysis. (auth)

44042 (NMI-2130) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report, September 25, 1964. (Nuclear Metals. Div. of Textron Inc., West Concord, Mass.). Sept. 25, 1964. Contract AT(30-1)-2784. 29p.

Methods for fabrication of tubes of tungsten and rhenium–tungsten alloys are evaluated. Some of the re-extruded tubing is drawn with a deformable mandrel consisting of the molybdenum extrusion filler, which is removed with an acid drill after the drawing. Further reductions of reference-size 25 wt % Re–W tubing are obtained at 510 and 580°C by plug drawing and sinking. Re-extruded alloy tubing is examined in ring compression tests and metallography. The effect of annealing on the ductility of additional reference-size tubing is checked. The deformation behavior of the high-purity beryllium crystals is evaluated by zone-refining techniques. The effects of interstitial elements (C, N, and O) on deformation behavior is studied by using titanium scavengers in the crystals. (N.W.R.)

44043 (NMI-2131) FUNDAMENTAL AND APPLIED RESEARCH AND DEVELOPMENT IN METALLURGY. Progress Report, August 1964. (Nuclear Metals. Div. of Textron Inc., West Concord, Mass.). Oct. 8, 1964. Contract AT(30-1)-2784. 27p.

Abstracts are presented on the two sections of the report. (N.W.R.)

For abstracts of individual sections see: 44100 and 44143.

44044 (ORNL-3670) METALS AND CERAMICS DIVISION ANNUAL PROGRESS REPORT FOR PERIOD ENDING JUNE 30, 1964. (Oak Ridge National Lab., Tenn.). Oct. 1964. Contract W-7405-eng-26. 317p.

Progress is reported in the four fields of fundamental research on reactor materials, long-range applied research, reactor development support, and other program activities. A total of 33 sections are presented in these four fields, and separate abstracts were prepared for all of the sections. (D.L.C.)

For abstracts of individual sections see: 43360, 43773, 43779, 44045, 44046, 44047, 44048, 44049, 44050, 44051, 44052, 44053, 44054, 44055, 44056, 44101, 44102, 44103, 44104, 44145, 44146, 44147, 44148, 44149, 44150, 44151, 44152, 44289, 44290, 45003, 45076, 45085, and 45086.

44045 (ORNL-3670(p.3-5)) BASIC RESEARCH ON SINTERING. C. S. Morgan and C. S. Yust (Oak Ridge National Lab., Tenn.).

Creep on specimens of ThO_2 and ThO_2–0.60% CaO was studied to obtain data for correlation with densification rates. The initial creep rates of the two materials differed markedly at 1465°C, but after 500 hr, the rates were about equal. The changes in the creep rate of the ThO_2–0.60% CaO specimens were probably caused by a redistribution of the calcium. The densification rate of UO_{2+x} was investigated at oxygen-to-uranium ratios of 2.05 to 2.25 in the temperature range of 900 to 1400°C. The maxima and minima that were present in the initial densification rate of ThO_2 were not found in the urania specimens. Beginning studies of grain growth in thoria show that the growth rate is higher in air than in argon. (auth)

44046 (ORNL-3670(p.6-10)) CRYSTAL PHYSICS. G. W. Clark (Oak Ridge National Lab., Tenn.).

A series of lanthanide germanomolybdates of the general formula R_2GeMoO_8, where R is a lanthanide, has been synthesized as single crystals and characterized. Significant paramagnetic anisotropy has been observed in these and in crystals of ErOOH. Small additions of B_2O_3 to the solvent $Li_2O \cdot 2WO_3$ enhanced the growth rate of ThO_2 crystals fivefold with only a small decrease in crystal quality. The crystalline mosaic spread on (111) faces of ThO_2 crystals was determined to be about 2′ of arc by x-ray methods. Crystals of ThO_2 doped with rare-earth ions are being grown, and the electronic character of the rare earths in this host lattice is being studied by electron-spin resonance and by optical absorption methods. Crystals of tri- and tetravalent metal silicates have been grown greater than 1 mm on an edge from $Li_2O \cdot 2WO_3$ solutions. The phase transformation temperature of $ThSiO_4$, a sluggish system, from tetragonal (thorite) to monoclinic (huttonite) was determined to be 1225 ± 10°C by growth of the individual phases just above and below this temperature. Two broad areas of crystal synthesis by the hydrothermal method are being studied. The first includes silicates, ferrisilicates, and similar compounds—germanates, ferrigermanates, and aluminogermanates. The other area includes oxides and multiple oxides, especially those containing elements of the lanthanide series or the first transition series. The temperature dependence of the magnetic susceptibility of Er_2GeMoO_8 has been measured from 50 to 400°K. Optical absorption spectra of crystals whose diameters are greater than 0.13 mm are being obtained with a newly developed sample holder. (auth)

44047 (ORNL-3670(p.27-30)) REACTIONS AT METAL SURFACES. J. V. Cathcart (Oak Ridge National Lab., Tenn.).

Studies of fundamental oxidation mechanisms of metals have continued. Several correlations were found between the rate of oxidation and the degree of disregistry in the crystal lattice of the oxide on copper, and these findings led to the speculation that the oxidation rate anisotropy exhibited by copper was caused by a corresponding anisotropy in the oxide lattice disregistry. It was discovered that thin anodic oxide films on tantalum and niobium suppressed the formation of additional surface oxide during subsequent thermal oxidation, yet permitted the dissolution of oxygen in the substrate metal. This made it possible to study in detail the effect that the stresses accompanying oxygen solution have upon the oxidation mechanism. The extension of techniques developed during these anodization studies produced a highly sensitive method for studying the diffusion of radioactive tracers in tantalum and niobium. The method made possible the detailed determination of penetration curves within 1 to 2 μ of the specimen surfaces and has proved particularly useful in studying low-temperature diffusion. (auth)

44048 (ORNL-3670(p.56-63)) X-RAY DIFFRACTION RESEARCH. B. S. Borie (Oak Ridge National Lab., Tenn.).

Analysis of diffraction data from BeO single crystals irradiated at a variety of dose levels and temperatures has led to a qualitative understanding of the general radiation-damage mechanisms operating. Models involving displacement faults and spacing anomalies caused by defect clusters currently produce the best agreement with experimental observations. Work on the structure of thin cuprous oxide films on copper has continued with the extension of the diffraction model to include nonuniform film thicknesses. Significant improvement was thereby obtained in the agreement between observed and computed Fourier coefficients of oxide reflections and between average film thicknesses computed from line shape and integrated intensity measurements. An unusual effect of film structure on the Bragg spacings of 110 and 220 oxide reflections has also been described in terms of particular atomic configurations at the metal-oxide and the oxide-gas interfaces. (auth)

44049 (ORNL-3670(p.77-111)) HIGH-TEMPERATURE MATERIALS. W. C. Thurber (Oak Ridge National Lab., Tenn.).

The weldability of sheet specimens of the advanced niobium and tantalum alloys D-43, B-66, FS-85, C-129Y, and T-111 was evaluated by measuring bend transition temperatures after fusion welding by either gas tungsten-arc or electron-beam methods. Transition temperatures were generally below room temperature, testifying to the good weldability of these materials. Post-weld aging treatments demonstrated that D-43, B-66, and C-129Y were susceptible to embrittlement under certain conditions. A study of the systems Nb–V–Ti and Ta–V–Ti has indicated that several compositions in these ternaries are useful for brazing of refractory metals to produce joints capable of high service temperatures. Irradiation of Mo–0.5% Ti sheet at 60 to 160°C to integrated fast-neutron doses of approximately 10^{20} neutrons/cm^2 increased the bend transition temperature from 20 to 130°C. Postirradiation annealing at temperatures to 1200°C partially restored the ductility. Irradiation of Nb–1% Zr and D-43 did not embrittle these materials (as determined by the bend test) but did increase the yield strength by 50 to 70%. A postirradiation anneal for 1 hr at 1000°C restored the preirradiation yield strength of both alloys. Creep of D-43, B-66, T-111, and unalloyed tantalum has been tested over the temperature range from 1000 to 1600°C. At 1200°C the 1000-hr rupture strengths for tantalum, B-66, D-43, and T-111 are in the ratio 1:1.9:3.2:6.5. Pretest annealing markedly enhanced the creep properties of Nb–1% Zr at 982 and 1204°C. The contamination of refractory metals and alloys by the residual gases in vacuum systems has been systematically studied as a function of pressure, temperature, time, alloy composition, and metal surface-to-volume ratio. Empirical equations were developed to represent the effect of these variables on the contamination of Nb–1% Zr over the temperature range 750 to 1200°C. Low partial-pressure additions of CH_4 (approximately 10^{-7} torr) to the vacuum system reduced the contamination of TZM and unalloyed niobium but not that of the Nb–1% Zr alloy. The weight losses of several stainless steels and superalloys caused by evaporation in high vacuums at 760 and 980°C were measured and found to depend on temperature and the chromium and manganese contents of the alloys. Postevaporation creep testing of type 316 stainless steel demonstrated that thermally induced structural changes within the alloy, rather than evaporation, controlled the creep behavior. No aging effects were observed in Cb-752, but D-43 showed a marked aging tendency, which was attributed to changes in the morphology and composition of carbide precipitates in this alloy. Tungsten, molybdenum, and molybdenum-alloy tube shells with excellent surfaces have been produced by high-temperature extrusion, using no lubricant other than the self-produced volatile trioxides. The molybdenum-base materials were successfully warm drawn to defect-free tubing, and no significant contamination occurred during processing. Procedures are under development for the room-temperature flow turning of Nb–1% Zr and T-111 alloy tube hollows. Oxygen rendered the Nb–1% Zr alloy susceptible to rapid penetration by lithium at 815°C, but attack could be prevented by appropriate heat treatments in which the oxygen combined with zirconium to form ZrO_2. Protection was afforded for all oxygen levels up to that required to produce stoichiometric ZrO_2 (approximately 3500 ppm in Nb–1% Zr). Similar protection was not observed in a Nb–40% V alloy even though oxygen-contaminated unalloyed vanadium was inert to lithium. The electric resistivity and total hemispherical emittance of rhenium, T-111, D-43, and Nb–1% Zr were measured to temperatures as high as 1500°C. Several conventional noble- and refractory-metal thermocouples drifted less than ±10°C in 1000 hr in vacuum at 1450°C. (auth)

44050 (ORNL-3670(p.116-21)) MECHANICAL PROPERTIES. J. R. Weir, Jr. (Oak Ridge National Lab., Tenn.).

The objective is the study of the effects produced by reactor environments on the mechanical properties of materials. These environments consist of thermal and mechanical stresses imposed on the reactor structure, chemically reactive coolants, and neutrons produced by fissioning. The work in the past year has emphasized the study of problems associated with hydrogen and carbon dioxide as potential coolants and the problem of radiation damage to stainless steel. A hydrogen environment weakens some metals. It reduces the creep strength of Inconel, nickel, and copper, but does not affect that of iron and austenitic stainless steel. The mechanism by which hydrogen affects these materials is not clear; but evidence was obtained, using the electron microscope, that a hydrogen-dislocation interaction may be involved. A carbon dioxide environment strengthens and reduces ductility of alloys at elevated temperatures by carburizing them. Carburization may be inhibited in the stainless steels by an increase in the chromium content to above 20%, which leads to formation of a protective Cr_2O_3 film at the metal-oxide interface. Irradiation at 200 to 400°C increases the strength and decreases the ductility of stainless steel tested in the same temperature range. It was verified that this effect, which is not observed when the irradiation or test temperature reaches 600°C, is caused by fast neutrons. Irradiation at higher temperatures decreases high-temperature ductility without affecting strength; this is caused by thermal neutrons, very likely by the $^{10}B(n,\alpha)$ reaction introducing helium into the metal. A preirradiation heat treatment was found that can significantly improve the low-temperature postirradiation ductility of stainless steel. (auth)

44051 (ORNL-3670(p.132-41)) TUNGSTEN METALLURGY. W. C. Thurber (Oak Ridge National Lab., Tenn.).

Shapes of pyrolytic tungsten produced by the reduction of tungsten hexafluoride are being fabricated and characterized. Both sheet and tubular deposits have been produced under optimum conditions, and an evaluation of these deposits as to weldability and elevated-temperature stability has been undertaken. In addition, data have been obtained on the weldability, ductile-brittle transition tem-

perature, and creep strength of powder-metallurgy tungsten to provide a base line for comparison with the pyrolytic material. The feasibility of using a dispersed second phase to provide sources of mobile dislocations to enhance the ductility of tungsten is also being explored. (auth)

44052 (ORNL-3670(p.147-59)) ZIRCONIUM METALLURGY. M. L. Picklesimer (Oak Ridge National Lab., Tenn.).

The transformation kinetics in a series of Zr–Mo alloys and in a Zr–0.9 wt % Fe alloy were studied by electrical resistivity and metallography. The Zr–Mo alloys behaved much as the Zr–Nb alloys previously reported. The Zr–0.9 wt % Fe alloy results are difficult to interpret because three phases are observed over an appreciable temperature range. The effect of applied stress on the preferred orientation of hydrides precipitated in Zircaloy-2 during cooling was examined. The data were analyzed by use of a hydride pole figure. Stress reorientation of hydrides occurred only if the applied elastic stress was parallel to a high concentration of basal poles. Plastic strain caused the hydrides to precipitate parallel to tensile strain components and perpendicular to the compressive strain components. A technique for the rapid determination of an approximate (0001) crystallographic pole figure for Zircaloy-2 by use of Knoop microhardness measurements was developed. Only 36 impressions are required, if they are made in a specified pattern. The resulting pole figure is in excellent agreement with figures prepared from x-ray diffraction data. A technique and an analysis were developed for rapidly determining hydride and crystallographic (0001) pole figures in Zircaloy-2 by the use of a polarized-light microscope and quantitative metallography. The refractive indices were determined as a function of wavelength for the first time for anodized films formed on zirconium foil. The method also yielded accurate measurements of film thicknesses, but it failed for films formed by reaction with air, oxygen, or water, because these films intrinsically absorb in the ultraviolet and visible spectra. Single crystals of zirconium and Zircaloy-2 were grown in sizes up to 13 mm in diameter and 10 cm long by use of an electron-beam furnace. Many of the variables of the growth process were investigated, and most of the necessary requirements for reproducible growth of large quantities of single-crystal material are now determined. As-deposited bars of zirconium and titanium as large as 0.5 in. in diameter were successfully zone melted as many as ten successive passes. Appreciable purification was obtained in as few as four passes, and resistivity ratios as high as 450 were measured. (auth)

44053 (ORNL-3670(p.166-72)) ARMY REACTORS PROGRAM. R. J. Beaver and G. M. Adamson, Jr. (Oak Ridge National Lab., Tenn.).

Procedures developed previously for making 30-g batches of high-density Eu_2O_3 and europium molybdate were used with slight modification in scaling up to a 500-g quantity. Compatibility of these arc-melted compounds with stainless steel was indicated in preliminary tests. Full-size neutron absorbers containing 37% Eu_2O_3 in stainless steel did not change significantly in dimensions on irradiation in the SM-1 to estimated exposures of 5.9 and 13.5 Mwyr. Experimental fuel elements and neutron absorbers in test in the SM-1 were undamaged by limited exposure. Hot-cell inspection of type 403 stainless steel control-rod-drive pressure thimbles used in the PM-1 and PM-3A showed pitting and cracking after relatively low exposures. The frequency of cracks in the cladding and the susceptibility to waterlogging of fuel elements from the SM-1 (first core loading) increased with reactor exposure. Irradiation test specimens containing spheroidal UO_2 "ideally" distributed in stainless steel, which represent the fuel material planned for core 3 of PM-1, were evaluated and are being tested in the ORR pressurized-water loop. (auth)

44054 (ORNL-3670(p.174-200)) GAS-COOLED REACTOR PROGRAM. A. E. Goldman and W. O. Harms (Oak Ridge National Lab., Tenn.).

The support of the Experimental Gas-Cooled Reactor includes receipt of the reactor fuel and the fabrication of instrumented fuel assemblies, assistance with welding problems, and measurements of stress-rupture properties of the fuel cladding material. The creep of the graphite moderator material under irradiation was found to help the material accommodate in-service strains and to be predictable by a theoretical model. Effects of irradiation on several physical properties of graphite were studied. A major effort is the development of unclad fuels for advanced gas-cooled reactors, especially graphite-base fuels containing dispersed pyrolytic-carbon-coated fuel particles. The properties of the coating were related to the conditions of deposition. The strain caused in the coating by irradiation was mathematically analyzed. An improved etching technique was found for preparing particles for metallography. Poison particles are also under study. Spherical graphite fuel elements have been tested by abrasion, crushing, impact, thermal shock, radiography, eddy-current methods, and infrared emission, and prepared for reactor irradiation. The results have been related to design and fabrication. A phenolic resin was a better binder for graphite fuel elements than a furan. High-temperature chlorination removed exposed thorium and uranium from the surface of graphite fuel elements. Fueled beryllium oxide has been irradiated to 1.6% burnup of the fuel atoms. Uranium can be leached from fueled beryllium oxide with nitric acid. Supporting research for gas-cooled reactors has been in diverse areas. Using x-ray diffraction and other techniques, a phase diagram was prepared for the system UC_2–ThC_2. Methods were devised for welding new high-strength nickel alloys. Creep-rupture properties of a British stainless steel were measured under irradiation. The ratchetting of stainless steel cladding on ceramic fuel was studied, and it was found that the effect could be decreased by use of copper foil as a lubricant between the fuel and cladding. The mechanism of structural changes in UO_2 irradiated at high temperatures was investigated, and the thermal conductivity of graphite was measured from 50 to 1000°C. (auth)

44055 (ORNL-3670(p.216-24)) MOLTEN-SALT REACTOR. A. Taboada (Oak Ridge National Lab., Tenn.).

Grade CGB graphite specimens were evaluated to determine the acceptability of this material for use as moderator in the Molten-Salt Reactor Experiment. Bulk density ranged from 1.83 to 1.87 g/cm^3. The spectrum of pore-entrance diameters was determined over the range from 100 to 0.02 μ. Lattice constants were measured to be $a_0 = 2.464$ A and $c_0 = 6.746$ A. Oxygen concentration in this graphite averaged less than 20 ppm and did not change with exposure to the atmosphere. Material intended for structural purposes was examined radiographically and found to meet the requirement specified. Stubs remaining in the MSRE heat exchanger were successfully sealed after some of the tubes had been cut off. Tensile properties were measured on welded specimens of INOR-8. When specimens had been stress relieved for 2 hr at 1600°F in

hydrogen, the tensile strength below 1000°F was lowered; ductility was lowered at room temperature but not at higher temperatures; the yield strength was lowered; and the specimens failed in the base metal rather than in the weld. Tensile properties of irradiated and unirradiated INOR-8 are reported for test temperatures from ambient to 900°C. Ductility was reduced at temperatures above 600°C. The effect of irradiation increased with decreasing strain rate. Postirradiation anneals did not affect the radiation-induced properties. Creep rates were measured on heats of INOR-8 for the MSRE, and tensile properties of this alloy were measured after various heat treatments. Specimens and capsule components from in-pile experiments were examined metallographically. Some INOR-8 and molybdenum specimens carburized in contact with graphite and fuel salt. Graphite and INOR-8 capsule components showed no evidence of attack. Autoradiography of graphite demonstrated a slight penetration at the surfaces. (auth)

44056 (ORNL-3670(p.228-50)) THORIUM UTILIZATION PROGRAM. D. A. Douglas (Oak Ridge National Lab., Tenn.).

Work is being carried out to simplify and reduce the cost of the Th–^{233}U fuel cycle. New processes were developed for applying pyrolytically deposited carbon coatings to fuel particles at markedly reduced costs, and it was demonstrated that these coatings are compatible with oxide particles produced by a new Chemical Technology Division technique. The remote fabrication of 1100 fuel pins was completed successfully in the Kilorod Facility by vibratorily compacting bulk oxides, prepared by sol-gel techniques, into zircaloy tubes. The experience is being used to develop the remote fabrication equipment to be installed in the Thorium–Uranium Fuel Cycle Development Facility that is being designed. From numerous irradiation tests on bulk oxides, it was found that the sol-gel produced oxide is an excellent nuclear fuel and that mixed oxides of thorium and uranium perform satisfactorily at much higher heat ratings than UO_2 alone. Stress is one of the more important parameters controlling the rate at which fission gas is released from ceramic fuels. Work has continued on the strengthening of metal fuels by alloying and dispersions. Irradiation tests of thorium–zirconium alloys were discontinued because of experimental difficulties. (auth)

44057 (ORNL-P-226) HOT CELL TECHNIQUES FOR THE EVALUATION OF FUELED GRAPHITE SPHERES. D. R. Cuneo, E. L. Long, Jr., and H. E. Robertson (Oak Ridge National Lab., Tenn.). [July 31, 1964]. Contract W-7405-eng-26. 29p. (CONF-654-4)

For Presentation at American Nuclear Society Meeting, San Francisco, Nov.-Dec. 1964.

Techniques and equipment developed for hot-cell handling of fueled graphite spheres are being utilized to evaluate this type of fuel element following irradiation at realistic temperatures and flux. Spheres of varying sizes and methods of manufacture have been studied. All types of spheres were fueled with pyrolytic-carbon-coated UC_2 or $(U,Th)C_2$. The techniques used include (a) gas sampling to test gaseous fission product retention; (b) gamma scanning to check relative burnups of several spheres in a single experiment; (c) determinations of weight and diameter changes, allowing one to check stability of cements and binders and types of graphite under irradiation; (d) compression and impact testing to learn what effects irradiation may have on these mechanical properties; and (e) metallographic examinations of selected specimens to determine irradiation effects on uranium migration, stability of particle coatings and to separate thermal effects from combined thermal and irradiation effects. (auth)

44058 (ORNL-P-351) DIFFUSION OF TITANIUM-44 AND VANADIUM-48 IN TITANIUM. J. F. Murdock (Oak Ridge National Lab., Tenn.). [Aug. 21, 1964]. Contract [W-7405-eng-26]. 13p. (CONF-711-2)

From Symposium on Body-Centered Cubic Materials, Gatlinburg, Tenn., Aug. 1964.

The diffusion of ^{44}Ti and ^{48}V in the body-centered cubic phase of iodide titanium has been studied over the temperature range 900 to 1550°C. The resulting Arrhenius-type plots show curvature with the apparent activation energies and frequency factors increasing with temperature. The various possible interpretations of this behavior are considered. (auth)

44059 (ORNL-P-406) METALLOGRAPHIC PREPARATION OF DICARBIDES OF THORIUM AND THORIUM-URANIUM. T. M. Kegley, Jr., and B. C. Leslie (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 27p. (CONF-619-2)

From 18th Meeting of the AEC Metallography Group, Los Angeles, June 1964.

Because of the strong tendency of ThC_2 and $(Th,U)C_2$ to hydrolyze, special techniques were required to metallographically prepare these carbides. Procedures developed included vibratory polishing inside a dry box and mechanical polishing outside a dry box. Pyrolytic carbon-coated particles and arc cast specimens were prepared using these procedures. Instead of the customary air etching, specimens were etched by immersing 1-5 min in 1 : 1 HNO_3–H_2O. The 1 : 1 HNO_3–H_2O solution passivates the polished surface presumably by forming a protective film which prevents reaction with moisture during the period required for microscopic observation and photomicrography. Short periods ($\frac{1}{2}$ to 1 min) of immersion in the 1 : 1 HNO_3–H_2O solution produced a passivated surface, while longer periods (5 to 45 min) etched the dicarbide specimens. Polarized light was particularly effective for observing the twinned structures of the dicarbides. (auth)

44060 (RFP-421) GROWTH OF ALPHA PLUTONIUM CRYSTALS FROM MELTS UNDER EXTREME PRESSURE. Roland B. Fischer (Dow Chemical Co. Rocky Flats Div., Golden, Colo.). Sept. 24, 1964. Contract AT(29-1)-1106. 18p.

Large-grained alpha plutonium has been prepared by slow solidification of melts under pressure of about 60 kbars. The technique opens the way to produce single crystals of alpha plutonium, and to obtain basic information previously unattainable. (auth)

44061 (SC-R-64-1330) METALLIZING CERAMICS USING A GAS DISCHARGE. D. M. Mattox (Sandia Corp., Albuquerque, N. Mex.). Sept. 1964. Contract [AT(29-1)-789]. 13p. (CONF-716-2)

From American Ceramic Society, Philadelphia, Sept. 1964.

A technique is described for metallizing ceramics using a d-c gas discharge to ionize a portion of the atoms to be deposited and an applied voltage to accelerate the ions to the ceramic surface. The use of the gas discharge allows cleaning of the ceramic surface before deposition and confines the energy flux to the surface of the ceramic giving a high effective surface temperature which enhances diffusion and chemical reaction. This technique allows the deposition of adherent metallizing layers without an excessive temperature rise in the bulk ceramic. Metallizing films of Al in

combination with Cu or Au have been used to deposit adherent electrodes on ferroelectric ceramics and films of Ti or Cr in combination with Cu or Au have been used to metallize high alumina ceramics. Subsequent brazing of the metallized ceramics give joint strengths of 3000 to 8000 psi. (auth)

44062 (TID-7697(p.4.6.1-10)) SPECIMEN HEAT TRANSFER FROM COMBINED CALORIMETRY AND GAMMA ACTIVITY DISTRIBUTION. B. Weidenbaum, M. F. Lyons, D. H. Coplin, and T. J. Pashos (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.).

A series of short-term capsule irradiations on highly enriched UO_2 were made in the GETR Trail Cable Facility in order to determine the specific power required to produce central melting in UO_2 fuel rods. The use of post-irradiation gamma scans of the capsules and calorimetric data to calculate the surface heat flux is discussed. The assignment of temperatures to structures in the irradiated UO_2 and the calculation of the thermal conductivity of the fuel are considered briefly. (D.L.C.)

44063 (UCRL-7591) PURIFICATION OF BERYLLIUM BY CRUCIBLE-FREE VACUUM MELTING AND DISTILLATION PROCESSES. R. F. Bunshah and R. S. Juntz (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 1964. Contract W-7405-eng-48. (CONF-729-1)

From International Conference on Beryllium, Philadelphia, Oct. 1964.

Crucible-free vacuum-induction melting, casting, and distillation processes were developed. They are used to purify beryllium. A very high purity polycrystalline material (total impurity content about 100 ppm atomic) is produced. The various purification mechanisms are discussed. (auth)

44064 (WAPD-282) A PRESSURE-DEFLECTION RELATION FOR A CLAMPED CIRCULAR PLATE IN THE PLASTIC RANGE. F. V. Naugle, J. E. McCauley, and F. O. Bingman (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). July 1964. Contract AT-11-1-GEN-14. 22p.

An evaluation was completed to determine pressure-deflection characteristics of small diameter clamped plates having radius-to-thickness ratios ranging from 1.5 to 16.0. Based on experimental data, an analytical model was developed that adequately describes plate deflection as a function of applied pressure. The rupture pressure of these clamped plates was estimated from a calculational model. The calculated rupture values were found to be in fair agreement with experimental rupture data. (auth)

44065 (AEC-tr-6484) APPLICATIONS OF CERAMICS IN THE NUCLEAR INDUSTRY. J. Elston. Translated from Bull. Soc. Franc. Ceram., No. 59, 25-45 (1963). 57p. (Includes original, 22p.).

A review is presented of the uses of ceramics in and outside reactors. Thermal insulation, fuel, pressure-tube, control-rod, and other reactor applications of ceramics are discussed, and the fabrication of UO_2, UC, BeO, etc. is described. The effects of irradiation on their properties are considered. The use of ceramics as crucibles in the preparation of nuclear materials is also discussed briefly. (D.L.C.)

44066 (LA-tr-64-27) ON NOVEL TYPES OF TANTALUM–NIOBIUM INFILTRATED OR SINTERED ALLOYS AND COMPOUND MATERIALS WITH GRAPHITE. R. Kieffer, H. Nowotny, and S. Windisch (Vienna. Universität and Vienna. Technische Hochschule). Translated by Gretchen Riese and John D. Farr (Los Alamos Scientific Lab., N. Mex.), July 15, 1964. 34p.

It was shown that the metals Nb and Ta could replace W and Mo in infiltrated alloys with Cu, Al, and/or Ag. The catalyzing action of additive metals and the infiltration of the metal skeletal bodies with Ni eutectic were studied. It is concluded that the Ta(W, Nb, Mo)–Ag(CU)–Al(Be. Sn, Cr) alloys can be used as high-temperature materials. Infiltration experiments with liquid melts and aqueous solutions of salts of Nb, Ta, Mo, W, and Re were carried out in an attempt to introduce these metals into porous graphite bodies. The infiltration was successful (30 to 70%) and resulted in increased crushing strength. Subsequent infiltration of these compound skeletal bodies with Cu, Ag, Cu–Si, and Mo–Si was only partially successful. (D.L.C.)

44067 (ORNL-tr-290) SINTERED UO_2—ITS PROPERTIES. Progress Report on the EL-4 Fuel, May 1, 1964. R. Delmas [France. Commissariat a l'Energie Atomique, Paris]. Translated by A. L. Monks (Oak Ridge National Lab., Tenn.), from report DM-1369. 9p.

Studies were carried out on the first fuel operation of the EL-4. The results which were obtained are summarized. The results include thermal behavior of sintered UO_2, oxidation of UO_2 during sintering, thermal conductivity, and fission gas retention. (D.L.C.)

44068 PREPARATION OF STABILIZED ZIRCONIA FOR MICROSCOPIC EXAMINATION. R. M. Slepian (Westinghouse Electric Corp., Pittsburgh). J. Am. Ceram. Soc., 47: 535-6(Oct. 21, 1964).

Zirconia was stabilized in a cubic solid solution of the fluorite type by the addition of various alkaline-earth and rare earth oxides. The samples were mounted in glass-filled diallyl phthalate powder. Other mounting materials proved to be unsatisfactory. Molding was done in mounts 1 in. in dia at 175°C and at a pressure of 8000 lb. A piece of metal shot was embedded in the middle of each microspecimen so that the sample would sink to the bottom of the etching solution and would be etched in the upright position. Boiling phosphoric acid was the only chemical etch satisfactory on all cubic solid solutions of zirconia stabilized with the alkaline earth and rare earth oxides that were studied. (P.C.H.)

44069 PREPARATION AND PROPERTIES OF ACTIVE THORIUM OXIDE FROM THORIUM HYDROXIDE. Wallace S. Brey, Jr., Burtron H. Davis, Paul G. Schmidt, and Charles G. Moreland (Univ. of Florida, Gainesville). J. Catalysis, 3: 303-11(Aug. 1964).

The circumstances in the preparation of active thorium oxide that control the properties of the oxide were investigated for thoria obtained by precipitation and thermal dehydration of the hydroxide. Surface area and crystallite size determinations, as well as some tests of catalytic activity, were used to characterize the thoria. In addition to the temperature of conversion of the hydroxide to the oxide, the reagent concentrations, methods of mixing and extent of washing in the process of preparing the hydroxide were found to affect strongly the nature of the resulting oxide. The dehydration of alcohols was found to be much more sensitive to the surface area of the catalyst than is the dehydrogenation. (auth)

44070 THE PREPARATION OF HIGH-PURITY THORIUM BY THE MAGNESIUM REDUCTION OF THORIUM TETRACHLORIDE. D. T. Peterson, E. E. Krupp, and F. A. Schmidt (Ames Lab., Ames, Iowa). J. Less-Common Metals, 7: 288-95(Oct. 1964). (IS-846)

A process is described for preparing high-purity tho-

rium metal in kilogram quantities. Magnesium metal is used to reduce purified $ThCl_4$ and to form a liquid thorium–magnesium intermediate alloy. This alloy is processed to a thorium sponge metal that is consolidated by arc casting and purified by electron-beam melting. Thorium metal containing a total of 250 ppm of impurities has been consistently prepared by this process. (auth)

44071 A MELTING FURNACE FOR STUDIES OF REFRACTORY METAL ALLOYS. A TOOL FOR ALLOY DEVELOPMENT PROGRAMS. V. R. Thompson and W. T. Reynolds (Crucible Steel Co. of America, Pittsburgh). J. Metals, 16: 809-13(Oct. 1964).

The design, construction, and operation of a consumable-electrode vacuum-arc furnace used for melting refractory metal alloys of the W–Ta–Mo–Nb system in a research program are considered. The melting procedure used is also discussed. Alloying is accomplished by simultaneously melting up to four rod electrodes. An important feature is the method of feeding electrodes to the furnace. Compositions of alloys produced, power requirements, and the effect of alloy composition on the power required for melting the alloys are included. (auth)

44072 EVERYDAY USES FOR MOLYBDENUM. Robert R. Freeman (Climax Molybdenum Co. of Michigan, Inc., Detroit). Metal Progr., 86: No. 4, 161-2; 164-5; 168(Oct. 1964).

The properties and uses of Mo and its alloys are discussed. Special attention is given to uses in non-nuclear industries. (P.C.H.)

44073 COMPARISON OF WATER-COOLED FUELS. J. A. L. Robertson and B. Cox. Nucl. News, 7: No. 10, 34-7(Oct. 1964).

A summary is given of the Geneva Conference papers on the unusual features of present water-cooled reactors and the design criteria and limitations, experience gained, and development areas for fuels of water-cooled reactors. (C.E.S.)

44074 FUEL FABRICATION, IRRADIATION TESTS AND PERFORMANCE IN REACTORS. S. Naymark and R. W. Dayton. Nucl. News, 7: No. 10, 38-41(Oct. 1964).

A summary is given of Geneva Conference papers on the fabrication, irradiation testing, and performance of ceramic and cermet fuels, dense carbide fuels, metallic fuel, and fluid fuels. (C.E.S.)

44075 NON-FUEL MATERIALS TECHNOLOGY. W. P. Chernock and J. Tobin. Nucl. News, 7: No. 10, 42-6(Oct. 1964).

A summary is given of Geneva Conference papers on non-fuel materials technology. Stainless steels, zirconium, magnesium alloys, beryllium and beryllium oxide, SAP and aluminum-base alloys, iron–aluminum alloys, structural steels, graphite, control rod materials, liquid-metal corrosion, and non-destructive testing are discussed. (C.E.S.)

44076 REACTOR PRESSURE-VESSEL MATERIALS. M. S. Wechsler and R. G. Berggren. Nucl. Safety, 5: 342-5(1964).

A review is presented of materials for reactor pressure vessels including ferritic steels, stainless steels, prestressed concrete, and low-alloy steels with high tensile strength. (J.R.D.)

44077 METAL-GAS REACTIONS. Sigfred Peterson. Nucl. Safety, 5: 360-6(1964).

A review is presented concerning the rapid combustion of reactor metals. Discussions are included on extinguishing metal fires, safe handling of liquid alkali metals, and mechanical effects of metal-gas reactions. (J.R.D.)

44078 JOINING OF OXIDES TO METALS THROUGH INTERMETALLIC COMPOUNDS. C. R. Faulkner and L. S. Williams (Commonwealth Scientific and Industrial Research Organization, Melbourne). Planseeber. Pulvermet., 12: 111-18(Aug. 1964).

The technique of reaction-pressing intermetallic components is described, and factors in its application to the formation of refractory ceramic-to-metal seals are discussed. Evidence of the required degree of thermal expansion matching is presented, and experiments are reported on the nature of the reaction-pressing operation, on bonding at the ceramic interface, and on structural changes likely to occur during prolonged service at high temperatures. (auth)

44079 PRESENT STATUS OF NUCLEAR FUEL RESEARCH AND DEVELOPMENT IN JAPAN. Yoshiki Imai (Atomic Fuel Corp., [Tokyo]), Keizo Ikeda, Kikusaburo Nagashima, Eizaburo Nishibori, and Hiroshi Ohinoue. Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 1963, 1: 217-31.

The research and development status of metallic fuels, metal production, research reactor fuels, magnox reactor fuels, fuel rods, cladding materials, assembling, inspection techniques, ceramic fuels, and reprocessing is outlined. (C.E.S.)

44080 PREPARATION OF HIGHLY PURE BERYLLIUM OXIDE. J. Kubala. p.179-81 of "Reinststoffe in Wissenschaft und Technik." Berlin, A-V, 1963.

A survey of published information showed that although preparation of a sufficiently pure product is described for nuclear reactor use, it does not meet purity conditions for a reference standard. The following steps are briefly described for a high-purity product: preparation and prepurification of basic Be acetate; preparation of a chloroform solution of $Be_4O(CH_3COO)_6$ and removal of trace elements by extraction with 4 n HCl; distillation of the chloroform in vacuum; and preparation of BeO from purified $Be_4O(CH_3COO)_6$. High-purity BeO with 40% yield is obtained. The BeO spectrum showed hardly any visible silicon lines (Si-2516.123 and Si-2881.578 Å). (OTS)

44081 MATERIALS IN SPACE TECHNOLOGY. [Symposium, London, November 22, 1961]. G. V. E. Thompson and K. W. Gatland, eds. London, Iliffe Books Ltd., 1963. 280p. 65s. Distributed in the U. S. by Gordon and Breach Science Publishers, New York, $12.50.

Papers presented at the Symposium on Materials in Space Technology are given. Topics covered include: survey of the materials problem, new materials for astronautics, aluminum in space engineering, magnesium in space technology, beryllium in aerospace technology, high-strength steels, refractory metals for space, polymers in space, uses of graphite in space technology, development of nozzle materials, ablative materials for thermal protection, space radiations and their effects, high-energy radiation effects on materials, and environmental testing of equipment for space experiments. Separate abstracts were prepared for 3 of the 13 papers. One paper was previously abstracted for NSA and appeared as 16: 30825. (M.C.G.)

For abstracts of individual papers see: 44082, 44274, and 44275.

44082 BERYLLIUM IN AEROSPACE TECHNOLOGY. G. E. Darwin and P. G. Taylor. p.79-105 of "Materials in Space Technology." London, Iliffe Books Ltd., 1963.

The uses of beryllium in aerospace technology are described. Its properties for use as a structural material, in

instruments, as a heat sink, as a nuclear material, and as a rocket fuel are discussed. Production of beryllium metal, extrusions, sheet fabrication, roll forming, forgings, joining, surface treatments, and heat treatment are described. (M.C.G.)

44083 PLUTONIUM. Mieczyslaw Taube. Translated by Eugeniusz Lepa and Zbigniew Nanowski. A Pergamon Press Book. New York, The Macmillan Company, 1964. 262p. $8.50.

Information is included on the nuclear properties of Pu, chemical properties of Pu, physiological effects of Pu and health physics, Pu technology, Pu nuclear fuel, and role of Pu in development of nuclear power. 372 references are included. (P.C.H.)

44084 THE USE OF BERYLLIUM IN A HIGH-TEMPERATURE GAS-COOLED REACTOR. K. F. Alder (Australian Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). London, Inst. of Metals, 1961, 5p. (CONF-693-1)

From Conference on the Metallurgy of Beryllium, London, Oct. 1964.

A feasibility on a beryllium-moderated, high-temperature gas-cooled reactor employing nuclear fuels, partly dispersed in the reactor moderator is discussed. A large part of the research program is concerned with the development of fuel and moderator materials based on the element beryllium. The nuclear advantages and the metallurgical problems of the beryllium-based system are discussed. In particular, the basis for the existing metallurgical research program is presented; this covers the fabrication, properties, irradiation stability, and compatibility problems of beryllium metal and dispersions of uranium and thorium compounds in the metal. (auth)

Corrosion

44085 (EURAEC-1122) STUDIES OF STEEL CORROSION IN HIGH-TEMPERATURE WATER AND STEAM. Quarterly Report No. 8, April 1–June 30, 1964. (Société d'Études, de Recherches et d'Applications pour l'Industrie, Brussels). July 29, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 089-62-7-RDB. 75p.

The static corrosion tests on stainless steel AISI 304 in high-temperature water and steam were continued. The study of the effects of surface state, temperature, and physical state of the water on corrosion was completed. The research on oxidation in steam above 400°C was extended. It is confirmed that corrosion in the steam phase below 374°C depends on the steam state. Corrosion in saturated steam is similar to that observed in water at the same temperature and the effects of the surface state is that previously defined for this medium while corrosion in superheated steam is generally less pronounced and the surface state has no effect. Above 400°C corrosion in superheated steam becomes dependent on the surface state; surface work-hardening lowers the corrosion rate. The lasting advantage of mechanically treating the surfaces was verified by determining the oxidation kinetics at 450°C, using the H_2 diffusion method. The decrease in the corrosion rate of non-work-hardened specimens is extreamely slow, showing the advantage of surface work-hardening. Microscopic and micro-probe examinations were carried out on oxide films formed at 500°C on the non-work-hardened states demonstrate an oxidation mechanism depending on a double migration process. The outside layer contains practically only Fe which would thus be the only cation liable to diffuse, whereas the inside layer is mostly Ni and Cr enriched by comparison with the basic metal. The two layers are of the same thickness irrespective of the testing time, indicating that the opposing diffusion of anions and cations is approximately equal. Examination of two other grades of stainless steel (13 Cr and 20/25 Cr–Ni) in the surface work-hardened and the non-work-hardened states in water at 300°C and in steam at 400 and 500°C showed that the conclusions drawn for grade 18-10 are of a general nature for stainless steels. The intergranular corrosion occurring at 500°C is particularly pronounced for grade AISI 410. (auth)

44086 (KAPL-M-6172) AN ELECTROCHEMICAL STUDY OF THE CRACKING OF WELDED STAINLESS STEEL. M. E. Indig (Knolls Atomic Power Lab., Schenectady, N. Y.). June 19, 1964. Contract W-31-109-eng-52. 13p.

The results of an electrochemical study into the aspects of corrosion cracking of welded stainless steel in areas surrounding the weld are presented. Cathodic and anodic sites on stainless steel and Alloy 600 (Inconel) were found by potential and colorimetric studies. The weld areas were always cathodic. The effects of heat treatments for stress relief and differential aeration were shown to contribute to corrosion of stainless steel. (auth)

44087 CONTRIBUTION TO THE STUDY OF THE OXIDATION OF CARBON. F. M. Lang, P. Magnier, and S. May (CEN, Saclay, France). Carbon, 1: 33-45(Oct. 1963). (In French)

The examination of changes in nuclear graphite textures during oxidation made it possible to get a better knowledge of three problems: that of the anisotropy of some industrial graphites; that of the opening of small pores at the beginning of wear; and that of the differences in behavior between coke and pitch after graphitization. The study of carbons purified at high temperatures led to the discovery that they have about the same specific rates of oxidation in dry media (air or CO_2); this permits the assumption that, at a certain level at least, these carbons will show the same statistical distribution of active sites over their surfaces. Humidity plays an important part in oxidation kinetic, varying essentially according to the more or less great porosity of the graphite. (auth)

44088 GAS CHROMATOGRAPHIC AND GRAVIMETRIC STUDIES OF URANIUM OXIDATION MECHANISM. T. Kondo, E. D. Verink, F. H. Beck, and M. G. Fontana (Ohio State Univ., Columbus). Corrosion, 20: 314t-20t(Oct. 1964).

New insights into the mechanism of uranium oxidation in moist gases at 75°C (167°F) were made possible by concurrent studies employing gas chromatographic, volumetric, barometric, gravimetric, metallographic, and x-ray methods. The presence of uranium hydride beneath the oxide was verified. A hydride fracture mechanism is proposed in which growth and fracture of uranium hydride play vital roles in determining the oxidation rate. The hydride phase is transitory, which may explain why little importance has been attached heretofore to hydride formation. Hydrogen stimulates attack in the presence of moisture through formation of hydride. Oxygen's inhibitive action is related to retardation of hydride growth and cracking. Oxidation proceeds in at least two stages: the early stage obeys the relationship $\Delta W = k_1 t^n$ where $n \cong 1.5$, whereas the later stage is pseudo-linear. Oxygen diffusion to the oxide-hydride interface may be rate con-

trolling. The activation energy is low, 7-12 kcal/mole. (auth)

44089 A STUDY OF CORROSION FILMS ON ZIRCALOY-2 BY IMPEDANCE MEASUREMENTS. F. Barbesino, E. Brutto, R. Di Pietro, and R. Sesini (Laboratori CISE, Milan). Energia Nucl. (Milan), 11: 435-40(Aug. 1964).

A method based on the impedance measurements for the study of oxide films of Zircaloy-2 is described. Samples obtained in static conditions in autoclave and in dynamic conditions in pressure-tubes were examined. The impedance measurements were carried out by using different electrolytes: Na_2SO_4 N/10, KCl N/50. The method proved efficient for uncracked oxide films. The results obtained with the oxide layers with cracks and porosities are less significant, also by using a liquid that does not penetrate into the cracks, such as mercury. (auth)

44090 LOW-PRESSURE OXIDATION OF TANTALUM AT 1300°-1800°C. P. Kofstad (Central Inst. for Industrial Research, Oslo). J. Less-Common Metals, 7: 241-66 (Oct. 1964).

Oxidation of tantalum was studied at 1300-1800°C at oxygen pressures ranging from 10^{-4} to 1 torr. The reaction may be divided into three stages: an initial linear oxidation followed by a parabolic-like stage with decreasing reaction rate which, in turn, is succeeded by a final stage characterized by an increasing rate of oxidation with time. During the linear oxidation oxygen dissolves in the metal and the reaction is governed by the rate of chemisorption of oxygen on the metal surface. The second stage reflects a diffusion-controlled oxygen dissolution in the metal. The final stage is associated with growth of Ta_2O_5 on the surface; chemisorption of oxygen is an important rate-limiting factor and the increasing rate is due to an increase of the effective surface area available for chemisorption. The duration of the two first stages, or whether they will be observed at all, is dependent on the oxygen pressure and temperature. Above 1700°C oxide evaporation becomes increasingly important. (auth)

44091 ROLE OF SILICA IN THE OXIDATION RESISTANCE OF MOLYBDENUM DISILICIDE. George Todd and Eric Parry (Royal Armament Research and Development Establishment, Fort Halstead, Sevenoaks, Eng.). Nature, 203: 967-9(Aug. 29, 1964).

It is proposed that the unique resistance of molybdenum disilicide to oxidation is due to the fact that the metal oxide MoO_3 is volatile and rapidly evolves to leave a solid residue of silica melting only above 1700°C. (C.E.S.)

44092 CORROSION TEST LOOP COMPONENTS /MSRE/ (Engineering Materials). (Oak Ridge National Lab., Tenn.). (CAPE-1102)

Drawings (24) are presented for the corrosion loop known as the Delta TV stand. It was used to evaluate the compatibility of graphite and INOR-8 in a dynamic fluoride fuel. The loop is a forced convection loop operating at a maximum temperature of 1300°F circulating a fluoride salt $LiF-BeF_2-UF_4$. The loop consists of a centrifugal pump, heaters, coolers, and a drain tank. The loop and pump bowl are fabricated of INOR-8 which shows negligible corrosion attack, with absence of surface pitting or subsurface void formation. The frame for the loop is 7 ft ½ in. high, 66 in. long, and 29½ in. deep. Control instrumentation drawings are included. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

44093 DIMENSIONALLY STABLE AND CORROSION RESISTANT NUCLEAR FUEL. (to U. S. Atomic Energy Commission). French Patent 1,314,903. Dec. 3, 1962. Priority date Mar. 1, 1961, United States.

U-Zr-Nb alloys were prepared with a Zr:Nb weight ratio of 5:1.5. The alloys were rendered dimensionally stable and corrosion resistant by the following succession of treatments: cold rolling, short-time heating to effect a rapid transition in the gamma phase, prolonged heating to effect transition in the alpha + beta + gamma phase, cooling, short-time heating to effect a rapid transition in the gamma phase, and quenching. As an example, an alloy with 6.5 wt % Nb + Zr was treated as follows: rolled at 25°C to give a decrease in thickness of 12%, heated at 800°C for 15 min, heated at 650°C for 24 hr, cooled at 25°C, heated at 800°C for 15 min, and quenched. (NPO)

44094 URANIUM-TIN-ZIRCONIUM CORROSION RESISTANT ALLOY. H. S. Kalish and H. H. Hausner (to U. S. Atomic Energy Commission). U. S. Patent 3,147,098. Sept. 1, 1964.

A corrosion-resistant alloy consisting of 1 to 30% uranium, 1 to 10% tin by weight, and the balance zirconium was prepared. (AEC)

Fabrication

Refer also to abstract 43753.

44095 (CEA-R-2587) APPAREIL PILOTE DE FUSION PAR BOMBARDEMENT D'ELECTRODE ET COULE CONTINUE. APPLICATION A UN ESSAI DE FABRICATION PORTANT SUR 20 kg DE BARREAUX DE MONOCARBURE D'URANIUM. (Pilot-Scale Apparatus for Melting by Electron Bombardment and Continuous Casting. Application to the Trial Preparation of 20 kg of Uranium Monocarbide Rods). Jean Trouve, René Genard, André Treillou, and André Accary (France. Commissariat à l'Energie Atomique. Centre d'Etudes Nucleaires, Saclay). Aug. 1964. 48p.

A pilot scale electron beam furnace designed for continuous melting and casting of uranium-carbon alloys is described. This equipment allows the melting and casting processes to be completely automatically controlled, the cooling being carried out under vacuum and the discharge being effected without breaking the vacuum. In a preproduction run of 20 kg of slugs, the composition of practically all the pieces was controlled within ±0.1 per cent C. The output of the furnace was 2.2 kg/hour. (auth)

44096 (ML-TDR-64-217) TUNGSTEN EXTRUSION DEVELOPMENT PROGRAM. Final Technical Report. A. E. Riesen, C. T. Wang, and S. A. Worcester (Wah Chang Corp., Albany, Ore.). May 16, 1964. Contract AF33(600)-42395. 160p. (AD-605195)

Procedures were developed for preparation of W-3% Mo extrusion billets by arc casting and by pressing and sintering. Round extrusions were made to evaluate die lubrication and die coatings at 3200 to 4000°F with reduction ratios as high as 17:1. Efforts to obtain wrought extrusion billets by extruding large cast ingots at 2300°F and 2.6:1 were not successful because longitudinal cracking developed in the extrusion. Efforts to meet program target dimensional and surface requirements with arc-cast W-3% Mo were unsuccessful. However, extruded T sections of W up to 138 in. long having surface finishes better than 100 RMS and dimensional run-out within .010 in. were successfully produced from pressed and sintered starting material. The extrusion conditions necessary to achieve the program target dimensions resulted in a hot-worked microstructure which has a high ductile-brittle transition temperature and relatively low strength. Because of the

undesirable microstructure achieved and the lack of requirement for W extrusions of the target configuration, the program was terminated at the end of the Phase III effort. (auth)

44097 (ML-TDR-64-228) DEVELOPMENT OF 2400°F FORGING DIE SYSTEM. T. Watmough and Paul R. Gouwens (Illinois Inst. of Tech., Chicago. IIT Research Inst.). May 28, 1964. Contract AF33(600)-42861. 155p.

The technology of using high-temperature dies for closed die forging was further advanced by a program having three broad objectives: (1) extend the die temperature beyond the 1600°F previously achieved, and determine the upper temperature limit of Inconel 713C for forging steel; (2) evaluate the possibility of using the high-temperature die system to reduce the number of forging sequences required to form a part; and (3) develop materials and techniques for raising the die temperature to 2400°F and use such a system for forging a molybdenum alloy. The upper operating temperature limit of Inconel 713C forging dies was determined by progressively increasing the load and temperature conditions of the die. Ultimate failure occurred by gross cracking at 1900°F under a 1000-ton load while forging steel. Using the die system operating at 1500°F, it was demonstrated that a steel aircraft part could be forged in a single step rather than the five die sequences normally required for the part. This was accomplished by introducing the concept of flash containment by a completely trapped die, thus combining the forging process with some features of extrusion. The part was produced directly from simple preform shapes of bars or round-cornered squares of the proper volume. Positioning of the billet within the die cavity influenced the ability to fill the cavity. For the 2400°F die development effort, a number of ceramic intermetallic, metal-ceramic composites, and refractory metals were screened for strength, oxidation resistance, and punch deformation behavior. Size limitations and material cost excluded promising candidates, so a compromise of tungsten alloy, molybdenum alloy, and nitride-bonded silicon carbide was eventually tested as hot dies. In the face of premature breakdown of oxidation coatings applied to protect the refractory metals, a transient liquid salt protection system was developed and used, and was readily renewable. Electrical resistance heating of the interior of the die and gas-fired heating between the top and bottom dies achieved surface temperatures equal or greater than the target 2400°F. In forging experiments, all of the selected compromise die materials failed to withstand the severe stresses imposed in attempts to forge a TZM molybdenum alloy shape. The ceramic failed under the triaxial stress system, while the refractory metal was itself indented by the workpiece. The temperature difference between die and workpiece could not be adequately maintained in the small sample, due to a quenching effect from the die and the molten salt pool used to protect the dies. The material state-of-the-art has not advanced to the point where dies can be used at 2400°F to forge TZM molybdenum alloy. (auth)

44098 (NLCO-920(p.37-45)) THE EFFECTS OF ALLOY CONTENT ON THE ROLLING PROPERTIES OF URANIUM RODS. H. W. Hesselbrock (National Lead Co. of Ohio, Cincinnati).

The effects of alloy content on the rolling properties of uranium rods were studied on a two-high, 16-inch by 24-inch, laboratory rolling mill. A special test in which billets were not reheated between passes showed the effects of strain hardening and recrystallization on rolling properties. (auth)

44099 (NLCO-920(p.47-55)) THE FLO-PEELING OF URANIUM METAL. P. H. Siegel (National Lead Co. of Ohio, Cincinnati).

An off-site test was conducted to determine the optimum operating conditions for machining uranium rods by the relatively new Flo-Peeling process. (auth)

44100 (NMI-2131(p.1-19)) FABRICATION OF TUNGSTEN AND TUNGSTEN-RHENIUM TUBING. G. I. Friedman, A. L. Geary, S. Isserow, and R. G. Jenkins (Nuclear Metals. Div. of Textron Inc., West Concord, Mass.).

The fabrication and properties of drawn and extruded tubes of tungsten and rhenium-tungsten alloys are evaluated. Reductions of 25:1 are obtained in reextrusions of both metals. To assist the investigation of CaC_2 as a core readily removed chemically, billets are being extruded with different diameters of CaC_2 in the molybdenum inside the rhenium-tungsten alloy. (N.W.R.)

44101 (ORNL-3670(p.67-76)) FUEL ELEMENT DEVELOPMENT. G. M. Adamson, Jr. (Oak Ridge National Lab., Tenn.).

Vapor deposition, or pyrolytic decomposition, was shown to be an effective and relatively simple technique for fabricating both fuel and cladding materials. Using this technique, high-purity UO_2 has been formed from UF_6 in a one-step conversion process. Many of the deposition parameters have been investigated. Other vapor-deposition studies have led to the successful fabrication of high-quality tungsten tubing, rhenium and tungsten-rhenium alloy tubing, and boron carbide and silicon carbide bodies. While good quality tungsten-rhenium deposits were achieved, the composition and thickness varied. Boron-carbon alloys were deposited with a wide range of composition and properties. Near-stoichiometric deposits of silicon carbide were obtained both as tubing and as a thermal-cycle resistant coating on graphite or tungsten. Miniature aluminum-base dispersion plates suitable for irradiation testing were fabricated from both U_3O_8 and niobium-coated UO_2 with excellent dimensional control and no cracking of the coating. Fabrication techniques were developed by which UC was sintered to high theoretical densities at temperatures much below those usually used. Sintering the UC was improved by the addition of small quantities of UBe_{13}, which cleaned the surface of the UC particles. Conditions that permit sintering to 95% of theoretical density were established. (auth)

44102 (ORNL-3670(p.173)) ENRICO FERMI FAST-BREEDER REACTOR. G. M. Adamson, Jr. (Oak Ridge National Lab., Tenn.).

During the past year, work on the current phase of the Fermi Project was completed and the final report issued. By selection of spacers, both the plate-spacing and element-stackup specifications could be met. (auth)

44103 (ORNL-3670(p.259-61)) SNPO-C NERVA PROGRAM ASSISTANCE. E. A. Franco-Ferreira (Oak Ridge National Lab., Tenn.).

Brazing alloys and conditions for René 62 and weldability of Inconel X-750 were evaluated. These nickel-base alloys are nozzle materials for nuclear rockets. (auth)

44104 (ORNL-3670(p.266-75)) TRANSURANIUM PROGRAM. D. A. Douglas (Oak Ridge National Lab., Tenn.).

Process development work was successfully completed for the various steps in the remote fabrication and inspection of target elements for the High Flux Isotope Reactor. Designing and testing of the equipment for the three

cells of Transuranium Facility are 60% complete. The equipment for the glove-box line, in which an initial loading of plutonium-bearing targets will be fabricated, has been assembled and tested. One test consisted of fabricating seven prototype elements, which were subsequently inserted into one of the reactors at Savannah River. Remote welding procedures are being developed and basic data on welding parameters are being obtained, so that a suitably programmed welding cycle can be specified. The first of four prototype elements being irradiated in the ETR was removed and examined after some six months of irradiation. With 40 at. % burnup of the original plutonium at a heat flux comparable to that expected in the HFIR, the target exhibited no serious design or fabrication deficiencies. One of the remaining three elements being tested will be moved to a higher flux position to achieve a heat flux from 1 to 1.6×10^6 Btu hr^{-1} ft^{-2}. (auth)

44105 (ORNL-P-2) PILOT PLANT PREPARATION OF U^{233}–ThO_2 SHARDS BY THE SOL-GEL METHOD, PREPARATORY TO PRODUCING POWDERS FOR VIBRATORY PACKING INTO FUEL TUBES. C. C. Haws, Jr. (Oak Ridge National Lab., Tenn.). [nd]. Contract W-7405-eng-26. 33p. (CONF-315-4)

From Norton Company's Symposium on the Technology of Powder Filled UO_2 Fuel Elements, Worcester, Mass., Nov. 1963.

Progress for the first five months of sol-gel pilot plant operation is reported. During this period 500 kg of 3% $^{233}UO_2$–97% ThO_2 (solid solution) was prepared in the form of shards that had a density 99% of the theoretical. A sustained throughput of 10 kg/day was demonstrated, and all product met expected chemical standards. The sol-gel process is a unique method for preparing feed materials suitable for vibratory-compaction fabrication of reactor fuel elements. The process upon which the present work was done consisted in the following steps: 1. preparation of a ThO_2 powder suitable for dispersion in weak nitric acid. The powder is prepared by hydrothermal denitration of thorium nitrate crystals at 500°C; 2. removal of ^{232}U daughter products from ^{233}U feed stocks by solvent extraction (this operation permits use of the lightly shielded glove-box type facility built for this work); 3. blending at 80°C of the ThO_2 powder and ^{233}U solution from steps 1 and 2 to form a stable sol; 4. drying of the sol to a gel state at 80°C; and 5. calcination and reduction of the dried gel at 1150°C under an argon-hydrogen atmosphere to produce shards which are then transferred to the rod-loading facility. The U/Th ratio, defined as $(100 \times {}^{233}U)/({}^{233}U + Th)$, was controlled to within 3.00 ± 0.05 following the start-up period. Gas-release values to 1200°C were ≤0.03 std. cc/gm for the calcined product, and ≤0.5 cc/gm for the crushed-sized powder as loaded into the fuel elements. The principal gases released by the product were H_2, CO_2, water, and CO(or N_2). Exposure of workers to radiation was satisfactorily low. Hand-forearm doses did not exceed 200 millirems/week as contrasted to a 1500 per week permissible dose. Pilot plant operation will continue until 1000 kg of product has been produced. (auth)

44106 (ORNL-P-249) OPERATING EXPERIENCE IN A SEMIREMOTE FACILITY FOR FABRICATION OF FUEL RODS CONTAINING $(^{233}U,Th)O_2$. J. E. Van Cleve, Jr., and A. L. Lotts (Oak Ridge National Lab., Tenn.). [July 29, 1964]. Contract W-7405-eng-26. 37p. (CONF-654-3)

For Presentation at American Nuclear Society Meeting, San Francisco. Nov.-Dec. 1964.

As a part of Thorium-Uranium Fuel Cycle Program, 1100 fuel rods containing over 878 kg of powdered oxide were fabricated (Kilorod Program) for use in BNL critical experiments. A brief description is given of the fabrication facility and the rod fabrication process, with emphasis on those areas which were modified. An account is given of the operating experience, e.g., utilization of time and manpower, material inventory, radiation monitoring, and economics. (D.L.C.)

44107 (ORNL-P-427) MATERIAL TRANSPORT IN SINTERING. C. S. Morgan, C. J. McHargue, and C. S. Yust (Oak Ridge National Lab., Tenn.). Sept. 1, 1964. Contract W-7405-eng-26. 16p. (CONF-726-1)

From British Ceramic Society Conference, Brighton, Eng., Oct. 1964.

Investigation of the densification kinetics of ThO_2 powder compacts containing varying amounts of coprecipitated CaO indicates that the initial densification as the temperature is being raised is primarily by dislocation movement, as is thought to be the case with pure ThO_2. The ThO_2–CaO compacts sinter more readily than pure ThO_2 compacts. The extent to which dislocation transport of material continues after attainment of isothermal conditions is considered. Reasons are advanced to show that model study results indicating volume diffusion transport of material do not rule out a substantial dislocation contribution. (auth)

44108 FISSION RECOIL IMPREGNATION OF GRAPHITE POWDER WITH XENON-133. J. O. Schiffgens and W. S. Diethorn (Pennsylvania State Univ., University Park). Carbon, 1: 85-6(Oct. 1963).

A convenient method of impregnating graphite powder with radioactive fission product ^{133}Xe is reported. The method involves the recoil impregnation of graphite with this species during thermal neutron irradiation of a mixture of graphite and water-soluble uranium nitrate hexahydrate. A more compact and easily handled mixture with better uranium distribution around the graphite particles is achieved by casting a mixture of molten hexahydrate and graphite. The casting method is described and evaluated. (P.C.H.)

44109 ELECTROPLATING ON ZIRCALOY-2 WITH COPPER. E. Caretta, R. Di Pietro, and R. Sesini (Laboratori CISE, Milan). Energia Nucl. (Milan), 11: 505-8 (Sept. 1964).

A method developed for electrolytic deposition of copper on Zircaloy-2 surfaces and subsequent heat treatment for the purpose of obtaining surface diffusion of the deposited metal are described. This treatment gives a thin barrier which reduces the absorbed hydrogen content of Zircaloy-2 when subjected to corrosion in organic coolants, without altering the mechanical properties of the structural material. (auth)

44110 INVESTIGATION OF CONDENSED BERYLLIUM THIN FILMS. L. S. Palatnik and A. I. Fedorenko (Khar'kov Polytechnic Inst.). Fiz. Metal. i Metalloved., 18: 69-72 (July 1964). (In Russian)

Effects of lining temperature, rate of deposition, and thickness on beryllium condensate tendency to cracking were studied. Crack initiation enlargement in beryllium condensate is analyzed. It is shown that sturdy beryllium films may be obtained at lining temperatures of 20 to 30°C. (R.V.J.)

44111 SINTERING OF Mo BY INDUCTION HEATING. Dieter R. Heuer. Hutnicke Listy, 18: 575-9(1963). (In Czech)

Comparison was made of this process with the common

heating techniques used for bar sintering and consisting of electric current passage. Induction heating produces uniform grain size and good quality products. This method may also be used for tungsten alloy sintering. (Rev. Metal Lit., 21: No. 8, Aug. 1964)

44112 ELECTROCHEMICAL AND ION BOMBARDMENT ETCHING OF PYROLYTIC GRAPHITE. Aram Tarpinian. J. Am. Ceram. Soc., 47: 532-3(Oct. 21, 1964).

Oxidizing solutions previously used for etching graphite were successfully utilized as the electrolyte for electrochemical polishing of pyrolytic graphite. The electrolyte was a solution of 800 ml concentrated phosphoric acid, 600 ml distilled water, 160 g potassium dichromate, and 10 g iron chloride. The results with electrochemical polishing show that much of the pitting was associated with scratches created during mechanical polishing. In argon ion bombardment, at 20-μ argon pressure and 4000-v driving potential, a fine fibril structure radiates from the vertex of the cones. Microstructures resulting from mercury ion bombardment, at 1-μ mercury vapor pressure and a driving potential of 100 v, were characterized by laminar features. Based on the similarity between microstructures revealed by ion bombardment etching and electrochemical etching, it appears that both the laminar and leaflike patterns represent structural discontinuities of the material and are not artifacts. (P.C.H.)

44113 METALLOGRAPHIC PREPARATION OF SINTERED CeO_2. C. E. Williams, A. E. Calabra, and D. L. Marts (Dow Chemical Co., Golden, Colo.). J. Am. Ceram. Soc., 47: 538(Oct. 21, 1964).

A method is described for the metallographic preparation of sintered CeO_2. The best etching method found was immersion in a 1:1 solution of 48% HF and distilled water for 15 min at ambient temperature. This was followed by swabbing for 1 to 2 sec with a 1:1 solution of concentrated HCl and distilled water to remove a thin residue formed during etching with HF. The specimens were then washed in cold water and dried. The resulting specimen was very porous, and a large number of inclusions appeared to be a second phase. The grains appeared to be equiaxed and the grain boundaries were well defined. (P.C.H.)

44114 METALLURGICAL ASPECTS OF SUBMERGED-ARC WELDING OF STEEL FOR REACTOR VESSELS. Julius Zeke. Jaderna Energie, 10: 336-43(Sept. 1964). (In Czech)

An investigation was made on the possibilities and methods of carrying out welded joints on the reactor vessel of the first Czechoslovak nuclear power station. The joints must be equivalent to basic material. The work was initiated with the new results of the investigation of metallurgic processes in welding bath, and with known thermal cycles and their influence on welded basic material. (auth)

44115 PLATING OF TUNGSTEN. Christopher Marzano. Plating, 51: 207-11(Mar. 1964).

Procedures for obtaining adherent electrodeposits on tungsten are described. After precleaning to free the metal surface of surface contaminants, the oxide layer is removed by pickling in an acid mixture of hydrofluoric and nitric acids followed by anodic etching in hot alkali solution. A chromium strike is most suitable to obtain adhesion on the metal in the as plated condition. However, other metal strikes such as copper, iron, and gold may be used under the given conditions. Procedures are given in detail to properly activate these metal strike deposits before final plating with other metals. (Rev. Metal Lit., 21: No. 8, Aug. 1964)

44116 THE ROLE OF POWDER METALLURGY IN DEVELOPMENT AND MANUFACTURING OF THE NEW TYPE NUCLEAR FUEL MATERIALS. PART I. F. Benezovskii. Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 3, 95-104(1964). (In Russian)

The economic and purity advantages as affected by hot compacting and sintering of U–Th–C system, used for nuclear fuel, are discussed. Phase diagrams of U–Th–C system and U–Zr(Hf, Nb, Ta)–C system are given. Discussion is given on the problem of stabilization of UC in the above systems and data on enthalpy of UC_2 formation. (Rev. Metal Lit., 21: No. 9, Sept. 1964)

44117 ELECTROPLATING OF SINTERED MATERIALS. H. Reinsch. Sprechsall, 96: 237-8(Dec. 20, 1963). (In German)

The electroplating of sintered materials such as Ti, Zr, Th, U, Mo, W, Ta, and Be using aqueous electrolytes is reviewed. Pretreatments such as etching for surface activation, and aftertreatments such as vacuum annealing at 500 to 1000°C are discussed. (Rev. Metal Lit., 21: No. 8, Aug. 1964)

44118 THE EFFECT OF TiO_2 ADDITIONS ON THE SINTERING OF UO_2. G. Arthur and D. Scott (International Research and Development Co. Ltd., Newcastle-on-Tyne, Eng.). Trans. Brit. Ceram. Soc., 63: 417-29(Aug. 1964).

The effect of additions of oxides in the density of UO_2 after sintering in hydrogen at various temperatures was determined. Of the oxides studied, TiO_2 had the greatest effect, followed by Nb_2O_5 and V_2O_5. In an attempt to elucidate the mechanism by which TiO_2 acts as a sintering aid, the UO_2–TiO_2 diagram in hydrogen was determined and found to be a simple eutectic system, the eutectic melting at 1645°C. Thus at temperatures at which the effect of TiO_2 on sintering is greatest (~1300°C), no liquid is present. The mechanism by which TiO_2 acts is, however, still obscure. (auth)

44119 VACUUM MELTING AND CASTING WITH SPECIAL REFERENCE TO URANIUM AND ITS ALLOYS. N. K. Rao, H. C. Katiyar, and M. M. Thomare. Trans. Indian Inst. Metals, 16: 239-46(Dec. 1963).

The mechanism of degasification occurring in vacuum melting along with the improvement in the quality attained are described. The problems relating to crucible mould set up and the coating materials are discussed. The melting and casting of highly reactive uranium metal and making of uranium-molybdenum alloy, which has much improved properties, are also described. (Rev. Metal Lit., 21: No. 9, Sept. 1964)

44120 WELDING PLUTONIUM-CONTAINING FUEL ELEMENTS INVOLVES A VARIETY OF AUTOMATIC AND MANY GAS METAL-ARC AND GAS TUNGSTEN-ARC TECHNIQUES TO PRODUCE HIGH-QUALITY REPRODUCIBLE WELDS FOR COMPLETELY FAILURE-FREE PERFORMANCE UNDER SEVERE REACTOR OPERATING CONDITIONS. L. C. Lemon, W. T. Ross, and W. J. Bailey (General Electric Co., Richland, Wash.). Welding J. (N.Y.), 43: 847-53(Oct. 1964).

A variety of welding techniques were developed for plutonium-containing fuel elements, test assemblies, coextrusion billets and foils. Manual and automatic methods were applied to Zircaloy, Al, and stainless steel cladding, 0.005 to 0.350 in. thick. Zircaloy welding techniques were developed chiefly for application to 19-rod cluster fuel elements for the Plutonium Recycle Test Reactor (PRTR). Reproducible closures were achieved on foils, pins, rods, tubes, plates, and billets. Once-through yields as great as

99.5% were achieved, and all yields were improved by reworking rejects. Fuel materials enclosed include alloys of Al–Pu, Al–Pu–Ni, Zr–Pu, U–Pu, and Al–^{233}U; pellets of UO_2–PuO_2, MgO–PuO_2, ThO_2–PuO_2, and ZrO_2–PuO_2; and compacted powders of UO_2–PuO_2, ZrO_2–PuO_2, and MgO–PuO_2. The high quality and reproducibility of the welds are supported by the completely failure-free performance under severe reactor operating conditions. (P.C.H.)

44121 PORTABLE TUBE WELDER (Engineering Materials). (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). (CAPE-1108)

Drawings (2) are presented for a remotely controlled welder that automatically fusion welds small-diameter thin-wall stainless steel and Inconel tubing under difficult field welding conditions and on a large volume basis. It operates in an inert-gas atmosphere to prevent damage to the metal through oxidation. The tool is capable of making welds many times faster than was possible by hand methods and consistently makes welds of high quality, eliminating manual error and 100% x-ray examination. For a listing of individual titles, see the Engineering Materials List (TID-4100). (C.E.S.)

44122 THE USE OF CALCIUM FLUORIDE VESSELS FOR URANIUM SMELTING. P. Rado (Worcester Royal Porcelain Co. Ltd., Eng.). 23p. (CONF-656-4)

From 9th Annual Minerals Symposium, Moab, Utah, May 1964.

A description of the method of fabricating such nonporous, impervious CaF crucibles for production scale use is given. Calcium fluorides have the highest thermal expansion of all ceramic products and are the only ceramics fully resistant to hydrofluoric acid and fluorides, apart from their outstanding refractory properties. Their use in the actual smelting of enriched uranium is described and they are compared with other types of vessels. There are a number of references in the literature regarding the use of calcium fluoride as a material for reduction containers, but these concern porous vessels that would not yield the full benefit of dense calcium fluoride vessels. (P.C.H.)

44123 METHOD OF MANUFACTURING FUEL PLATE ASSEMBLIES FOR NEUTRONIC REACTORS. (to U. S. Atomic Energy Commission). French Patent 1,283,658. Dec. 26, 1961. Priority date Mar. 24, 1960, United States.

A method is described for mechanically joining a number of parallel fuel plates to supporting side plates. The fuel plates are dovetailed at two opposite edges and inserted with these edges in grooves in the side plates. The loose assembly is put in a heated clamp after which a compression force perpendicular to the grooves is exerted on the proper edges of the side plates. (NPO)

44124 IMPROVEMENTS IN HEAT EXCHANGERS AND IN JACKETING FUEL ELEMENTS APPLIED IN NUCLEAR REACTORS. (to Compagnie Française Thomson-Houston). French Patent 1,285,420. Jan. 15, 1962. Filed Jan. 13, 1961.

Parallel, equidistant strips of some welding-inhibiting material were inserted between two metal plates (Al, stainless steel, Zircaloy) after which the plates were joined by hot rolling. The plates can be flat or have fins on their exterior surface. The welded assembly is put between two proper matrices and inflated at the non-welded spots by introduction of a pressurized fluid. The result is a plate-shaped element incorporating a number of parallel tubes, which are filled with fuel pellets. These plates can be assembled between side plates or a single plate can be repeatedly folded back. To reduce parasitic neutron absorption the strips between the tubes can be perforated. (NPO)

44125 METHOD OF MANUFACTURING FUEL ELEMENTS. (to United Kingdom Atomic Energy Authority). French Patent 1,304,439. Aug. 13, 1962. Priority date Oct. 24, 1960, Great Britain.

A method is described for loading a tubular jacket with ceramic fuel pellets that have a slightly greater diameter than the jacket at ambient temperature. The jacket, connected with a pellet magazine, is placed in a tubular, silica induction furnace, heated until it is sufficiently dilated, loaded with a column of pellets, and cooled. This method improves the contact between fuel and jacket and thus improves heat transfer. (NPO)

44126 COHERENT ELEMENTS FOR NUCLEAR REACTORS. (to U. S. Atomic Energy Commission). French Patent 1,325,166. Mar. 18, 1963. Priority date May 17, 1961, United States.

Fuel elements and control rods were manufactured by mixing a ceramic fissile, fertile, or neutron-absorbing material with a vitreous binding and/or dispersing agent that itself can contain nuclear material. The mixture is molded by compressing, extruding, or vibrating at 400 to 700°C. (NPO)

44127 IMPROVEMENT IN FUEL ELEMENTS FOR ATOMIC PILES. (to United Kingdom Atomic Energy Authority). French Patent 1,335,835. July 15, 1963. Priority date Oct. 11, 1961, Great Britain.

A finned fuel element was manufactured by inserting end plugs and nuclear fuel in an ordinary jacket tube and rolling this composition in such a manner that the jacket is brought into close contact with the fuel, the plugs are pressure welded to the jacket, and fins are formed on the jacket. Both the fuel and the plugs can have fastening grooves into which the jacket is pressed during the rolling operation. Also the plugs can be welded to the jacket prior to rolling. The fuel may be preliminarily coated with a bonding material; after rolling, the fuel element is then subjected to a thermal treatment to bond the jacket to the fuel. (NPO)

44128 TUNGSTEN TUBING EXTRUSION BILLET. J. G. Hunt (to U. S. Atomic Energy Commission). U. S. Patent 3,150,936. Sept. 29, 1964.

An extrusion billet was developed for the production of seamless tungsten tubing wherein a frangible core such as graphite encapsulated in stainless steel is used as a core material inside a tungsten sleeve to facilitate core removal. (AEC)

Properties and Structure

Refer also to abstracts 44497, 44498, 44680, 44683, 44742, and 44827.

44129 (AECL-1989) THE EFFECT OF ORIENTED HYDRIDE ON THE MECHANICAL PROPERTIES OF ZIRCALOY-2 TUBING. G. C. Wootton (Atomic Energy of Canada Ltd., Chalk River, Ont.). Mar. 1964. 23p.

Transverse specimens containing hydrogen from Zircaloy-2 pressure tubes have been cooled under a stress of 16,000 psi and the tensile properties measured. The orientation of the hydrides was relatively unaffected. Strength and ductility were unaffected by 125 ppm of hydrogen and although strength was unaffected, ductility was decreased by 325 ppm. Cold-drawn and tube reduced tubing were examined for the effect of oriented hydrides and varying transverse to axial stress ratios on burst properties.

For the hydrogen concentrations studied, 15, 40, and 200 ppm, only the 200 ppm had a pronounced effect on strength and ductility when burst after cooling under stress to orient hydrides. Cold-drawn tubing appeared to be affected at lower hydrogen concentrations than tube reduced. (auth)

44130 (ARL-64-122) THE ELECTRICAL BEHAVIOR OF REFRACTORY OXIDES. [PART] II. R. W. Vest, J. A. Crawford, and W. C. Tripp (Systems Research Labs., Inc., Dayton, Ohio). Aug. 1964. Contract AF33(657)-10815. 49p.

The research was directed toward achieving a more fundamental understanding of charge and mass transport mechanisms in refractory metal oxides. Special research apparatus and instrumentation was developed in order to carry out the experimental program. A computer-oriented study was conducted to assist in the analysis of dielectric loss data. The program was shown to be successful with a representative set of experimental measurements. The defect structure of monoclinic zirconia was investigated by measuring the oxygen partial pressure dependence of the electrical conductivity and sample weight. Techniques were developed to calculate the degree of non-stoichiometry and the mobility of the charge carriers from electrical and weight change data. ZrO_2 was found to be an amphoteric semiconductor at 1000°C with the transition from n-type to p-type conductivity occurring at 10^{-16} atmospheres. The predominant defect in the oxygen recess region was shown to be completely ionized zirconium vacancies. The positive holes arising from the zirconium vacancies were found to have an extremely small mobility. (auth)

44131 (BM-RI-6539) ROLLED MOLYBDENUM SINGLE CRYSTALS. DEFORMATION TEXTURES, RECRYSTALLIZATION, AND TRANSITION TEMPERATURE. R. Blickensderfer, R. Siemens, G. Asai, and H. Kato (Bureau of Mines. Albany Metallurgy Research Center, Ore.). Mar. 1964. 37p.

Some relationships were established among crystallographic orientation, rollability, deformation texture, annealing behavior, slip planes, and ductile-brittle bend transition temperature of molybdenum single crystals. Six large molybdenum single crystals obtained from an ingot melted by electron beam were oriented by x-ray diffraction and rolled on crystallographic planes of low indices in a known direction. During room temperature rolling, cleavage occurred on {100} type planes. At 300°C the crystals were rolled to 95-percent reduction in thickness. The crystals (001) [110] and (011) [100] were most easily rolled. Pole figures were used to correlate the deformation textures of the rolled crystals with the initial crystallographic orientation. Several of the textures which developed could be explained as a rotation about a ⟨110⟩ axis of symmetry. The cube crystal (001) [100] retained much of its "cubic" orientation. The (001) [110] crystal developed the simplest texture, whereas the (211) $[11\bar{3}]$ and (211) $[1\bar{2}0]$ crystals developed the most complex textures. The 1-hour recrystallization temperature of the crystal (211) $[11\bar{3}]$ was 700°C, which is about 300°C lower than that of commercial polycrystalline molybdenum. The poles of the slip planes (as determined from gross slip lines at relatively low magnification) tended to lie within 20 to 60 degrees of the pole of the rolling plane. The Knoop hardness was slightly dependent upon crystallographic orientation but more dependent upon rolling direction. The ductile-brittle bend transition temperature was dependent upon the rolling orientation and the dislocation density. (auth)

44132 (CALT-221-4) AMORPHOUS PHASE IN PALLADIUM–SILICON ALLOYS. AEC Research and Development Report No. 29. Pol Duwez, R. H. Willens, and R. C. Crewdson (California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials). Aug. 1964. Contract AT(04-3)-221. 8p.

Amorphous structures can be obtained by very rapid cooling from the liquid state in Pd–Si alloys containing from ~15 to 23 at. % Si. Evidence for the amorphous nature of these alloys include electron and x-ray diffraction patterns, metallic conductivity, and crystallization on heating. The conditions for formation of amorphous structures are discussed. (D.L.C.)

44133 *(CRRM-1200) THE EFFECT OF COOLING* RATE ON THE HARDNESS OF ZIRCONIUM–NIOBIUM ALLOYS. B. A. Cheadle (Atomic Energy of Canada Ltd., Chalk River, Ont.). June 1964. 23p. (AECL-2039)

The effect of cooling rate and niobium content on the hardness of Zr–Nb alloys was investigated using a Jominy end quench test. Specimens cooled in this test were subjected to a wide range of cooling rates from a water quench (1000°C/second) to an air cool. The composition of the alloys varied from Zr–2.3% Nb to Zr–5.3% Nb. The maximum as quenched hardness of alloys containing more than 2.5% Nb was not produced by a water quench but by a slower cooling rate of 22°C/second. After aging, the water quenched material hardened appreciably to the highest value observed, for the alloy but the hardness of the material cooled at 22°C/second changed very little. The maximum as quenched hardness of alloys containing less than 2.5% Nb was produced by the fastest cooling rate used (water quench). The observations that were made on the alloys using metallographic, x-ray diffraction, and electron microscopy techniques are reported. (auth)

44134 (EURAEC-1101) THE DEVELOPMENT OF A NEW DETERMINATION OF THE DUCTILE-BRITTLE *TRANSITION TEMPERATURE. Quarterly Report No.* M-64-542-26150. Quarterly Report No. 11, April 1–June 30, 1964. H. C. van Elst (Netherlands. Nijverheidsorganisatie, TNO, The Hague). July 31, 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract 068-61-11-RDN. 41p.

The arrest temperatures in the 1-in.-thick reactor vessel steels Ducol W 30 and 1.2 MD 07 as sheets were determined in the isothermal Robertson test. Contrary to earlier results 1-in. plates machined from 8-in. sheets of the 1.2 MD 07 steel, the stop temperature was between –35 and –40°C; i.e., at least 40°C lower. Charpy-V test transition curves were recorded and tensile tests performed. The effects of plate thickness on the Robertson test results was investigated with specimens of several thicknesses, machined from the same mild low-C construction steel sheet. In some of the Robertson tests, high-speed recordings of the propagation velocity of the running brittle fracture were performed both electronically with the aid of strain gages and photographically with the aid of a framing camera. The generation of stress waves using the magnetic interaction of two carriers of the discharge current of a high voltage, large capacity (low inductance) condenser was developed to such a stage that the stress wave attenuation test can also be performed in this way, instead of with the aid of explosives. The tensile stress wave apparatus was further developed. Though the recordings can now be performed with reasonable absence of disturbances the amount of explosive needed to effectuate

fracture is rather large and causes some trouble (noise and vibrations in available space). The stress wave attenuation test was performed on a fifth reactor vessel steel (Ducol W 30). Again a brittle-ductile transition could be observed, though its relation with the Robertson arrest temperature was not distinct. The reproducibility of the test was found to be improved by careful machining and polishing of the specimens. The effects of artificial aging of a low-C steel was determined in this way. To reveal the specific features of steel behavior, connected with the brittle-ductile transition, the stress wave attenuation test was also performed on Al. Of each of the 5 reactor vessel steels investigated, 150 specimen were prepared in a similar manner to those used in the stress wave attenuation test. These are now being irradiated in series of 30 in the H.F.R. in Petten at 80°C with 5 increasing doses (8.6×10^{17}; 2.5×10^{18}; $1.2^5 \times 10^{19}$; 5×10^{19}; 1.5×10^{20} nvt above 1 Mev, respectively. These are to be tested. (auth)

44135 (IS-1016) THERMAL DIFFUSIVITY MEASUREMENTS WITH RADIAL SAMPLE GEOMETRY. R. L. Carter and P. H. Sidles (Ames Lab., Ames, Iowa). Oct. 13, 1964. Contract W-7405-eng-82. 6p. (CONF-764-2)

From Thermal Conductivity Conference, San Francisco, Oct. 1964.

A new method for making thermal diffusivity measurements has been developed which is applicable to short, cylindrical specimens. Radial heat flow was employed with calculations based upon the methods of finite-difference calculus. Results were obtained on Armco iron, over the range from room temperature to the α-γ transformation which are in good agreement with data obtained by other methods. (auth)

44136 (JPL-TR-32-588) TENSILE PROPERTIES OF TUNGSTEN–3% RHENIUM AT TEMPERATURES OF 1400 TO 2900°C IN VACUUM. J. L. Taylor (California Inst. of Tech., Pasadena. Jet Propulsion Lab.). Apr. 1, 1964. Contract NAS 7-100. 10p. (N64-23945)

The tensile properties of recrystallized, doped powder-metallurgy tungsten–3% rhenium rod have been determined from 1370 to 2930°C in vacuum at a strain rate of 0.02/min. A comparison is made with recrystallized, doped powder-metallurgy tungsten, which shows comparatively poor ductility, and plasma-flame single-crystal tungsten, a very ductile material. The variation of strain-hardening exponent with temperature is shown for the two powder metallurgy materials. Tungsten–3% rhenium has the highest strength and the lowest ductility of the three materials. At a test temperature of ≈50% of the absolute melting point, both tungsten–3% rhenium and powder-metallurgy tungsten show decreased ductility and intercrystalline fracture associated with void formation and growth. Ductility does not increase with increasing temperature above ≈65% of the absolute melting point for tungsten–3% rhenium, as it does for powder-metallurgy tungsten, and this is attributed to the absence of stress-induced grain growth during testing. (auth)

44137 (IS-985) HIGH-FIELD DE HAAS-VAN ALPHEN EFFECT IN IRON AND NICKEL WHISKERS. A. V. Gold (Ames Lab., Ames, Iowa). [1963]. Contract [W-7405-eng-42]. 10p.

The de Haas-van Alphen effect was studied in iron and nickel whisker crystals using 200 kG impulsive fields. In iron a large number of high-frequency oscillations, which are associated with large portions of the Fermi surface, were detected; the highest frequency found so far is 3.72×10^8 G around [110]. Work on nickel was hampered by the complication that all large whiskers are found to grow with a hollow core. Nevertheless, oscillations with frequency close to 1.0×10^7 G were found near [001]. These oscillations complement the low-field torque results of Joseph and Thorsen, but it is not certain whether or not the new oscillations are associated with hyperboloidal "neck" regions of the Fermi surface. (auth)

44138 (KAPL-3031) FRACTURE TOUGHNESS DETERMINATIONS OF A302-B AND Ni–Mo–V ROTOR STEEL WITH VARIOUS-SIZED SPECIMENS. D. F. Mowbray (Knolls Atomic Power Lab., Schenectady, N. Y.). Mar. 13, 1964. Contract W-31-109-eng-52. 26p.

Plane-strain fracture toughness was determined as a function of temperature with small and large-sized specimens. The small-sized specimens, which were ⅛-in.-thick, single edge-notch sheet and Charpy-sized notched bend bars, were tested to determine their potential for irradiation studies. The large-sized specimens, 3.0-in.^{2} notched-bend bars, were made large enough to assure valid determinations of plane-strain fracture toughness. All the fracture specimens were prefatigue cracked. Two materials were investigated: quenched and tempered A302-B steel, and an embrittled Ni–Mo–V rotor steel. The Ni–Mo–V rotor steel was selected for testing because its properties are similar to those of irradiated A302-B steel. The results indicated that for these two materials: valid determinations of plane-strain fracture toughness only can be made with the small-sized specimens at extremely low temperatures; and the maximum shear-lip thickness at a given temperature is independent of specimen size. In addition, there is some experimental evidence which suggests that: the transition temperature defined by a vertical asymptote to the maximum shear-lip thickness-temperature curve coincides with the temperature region in which a transition in plane strain fracture toughness is evident; and it is possible to estimate the plane strain fracture toughness in the transition-temperature region from measurements of shear-lip thickness and yield strength. This estimating is done by equating crack-tip, plastic-zone size, and shear-lip thickness. (auth)

44139 (KAPL-3036) INVESTIGATIONS ON STRENGTHENING OF ZIRCALOY-4 BY HEAT TREATMENT AND ADDITION OF OXYGEN. A. E. Bibb, A. P. Beard, and J. R. Fascia (Knolls Atomic Power Lab., Schenectady, N. Y.). May 1964. Contract W-31-109-eng-52. 38p.

This investigation has shown the feasibility of producing increased strength in Zircaloy-4 at temperatures to 600°F by the addition of oxygen to the alloy and/or by the use of a β quench and 932°F α stabilizing heat treatment. The strength increases can be accomplished in the heat-treated Zircaloy-4 without deleterious effects on corrosion resistance, weldability, stress rupture properties, or fatigue properties. The α stabilizing heat treatment (2½ hr at 932°F) allows subsequent heating 2½ hr at 1300°F or 13½ hr at 1225°F with only partial loss of the strengthening induced by heat-treatment. (auth)

44140 (KAPL-M-6184) THERMAL CONDUCTIVITY OF UO_2–75 m/o ZrO_2. W. K. Anderson, C. J. Guare, and Ann Lalak (Knolls Atomic Power Lab., Schenectady, N. Y.). July 20, 1964. Contract W-31-109-eng-52. 17p.

Thermal conductivity calculations for UO_2–75 mole % ZrO_2 were made for fractional densities of 0.7 to 1.0, fission depletions of 0 to 30×10^{20} fissions/cm^3, and temperatures from 0 to 2600°C. The results are both tabulated and graphed. (D.L.C.)

44141 (MCW-1486) EQUILIBRIUM STRUCTURES IN THE HIGH-URANIUM–SILICON ALLOY SYSTEM. J. A. Straatmann and N. F. Neumann (Mallinckrodt Chemical Works. Uranium Div., Weldon Spring, Mo.). Oct. 23, 1964. Contract W-14-108-eng-8. 19p.

The boundaries and phase fields existing in uranium alloys containing from 30 to 3000 ppm by weight silicon at temperatures ranging from 500 to 1200°C have been determined from differential thermal, metallographic, and microprobe analyses. The phase diagram and the methods used to determine it are included as well as micrographs of the studied specimens. (auth)

44142 (NASA-CR-54123) GENERATION OF LONG-TIME CREEP DATA ON REFRACTORY ALLOYS AT ELEVATED TEMPERATURES. Fourth Quarterly Report, March 26, 1964–June 26, 1964. J. C. Sawyer and C. H. Philleo (Thompson Ramo Wooldrige Inc. TRW Electromechanical Div., Cleveland). July 1, 1964. Contract NAS 3-2545. 56p. (N64-28051)

The first of fourteen ultra-high vacuum creep furnace was installed and operated. The furnace, vacuum system, and auxiliary equipment for controlling and measuring temperature and measuring strain are described. Testing was initiated on Nb-base FS-85 alloy at 2000°F. After 300 hours a total extension of 0.025% was produced at an applied stress of 4000 psi. (auth)

44143 (NMI-2131(p.20-2)) FUNDAMENTALS OF SINGLE-CRYSTAL DEFORMATION IN ZONE-REFINED BERYLLIUM. D. F. Kaufman and L. R. Aronin (Nuclear Metals. Div. of Textron Inc., West Concord, Mass.).

The feasibility of adding titanium to zone-refined beryllium crystals to act as a scavenger for carbon is being investigated. The deformation, resistance ratio, tensile strength, and brittleness of beryllium crystals is studied along with the preparation characteristics. (N.W.R.)

44144 (NYO-2558-1) SOLIDIFICATION REACTIONS. Final Report. H. W. Weart (Cornell Univ., Ithaca, N. Y.). Oct. 14, 1964. Contract AT(30-1)-2558. 25p.

A theoretical and experimental study was made of atomic redistribution in eutectic solidification in alloys. In the theoretical part, the thermodynamics of irreversible processes were applied to steady-state phase transformations, and previous theories are shown to be equivalent to Onsager's variational principle. In the experimental part, studies were carried out on eutectics in the Cd–Sn and Sn–Zn systems and on the distribution of Cd and Tl in the Cd–Zn eutectic. (D.L.C.)

44145 (ORNL-3670(p.11-16)) DEFORMATION OF CRYSTALLINE SOLIDS. R. O. Williams (Oak Ridge National Lab., Tenn.).

The yield drop was investigated in tantalum, Cu–16 at. % Al, and Ag–6 at. % Al as a function of temperature and strain rate. Analysis of the data indicated that the yield drop results from the multiplication of dislocations at small strains. A series of measurements of the flow characteristics of an iron–carbon alloy as a function of strain rate and temperature provided direct evidence for the interaction of the strain field of a carbon atom with the stress field of a dislocation, leading to increased resistance to motion in a critical velocity range. The formation of a double kink in a dislocation occupies a prominent place in the interpretation of the flow properties of body-centered cubic metals at low temperatures. Previous calculations have neglected the applied stress and have obtained results that contradict experimental observations. The present calculations are expected to give a more correct solution. Investigating the effects of alloying on flow parameters, it was found that the addition of molybdenum to nickel increases the effect of temperature by decreasing the stacking fault energy. The development of compression textures was qualitatively as expected in common metals and alloys except for nickel and Cu–14 at. % Al. The rate of texture formation has been studied during compression and tension of copper, and it is hoped to deduce the effect of initial orientation on the rate of reorientation of individual grains. An isothermal calorimeter is being developed that can measure the recovery energy prior to recrystallization. The results have been promising although no satisfactory measurements have yet been possible. A value was obtained for the recrystallization energy for copper that agreed with accepted values in the literature. (auth)

44146 (ORNL-3670(p.17-20)) ELECTRON MICROSCOPY. J. O. Stiegler (Oak Ridge National Lab., Tenn.).

Transmission electron microscopy of deformed foils of body-centered cubic metals and alloys has shown that the effect of solid-solution alloying is similar to that of a lowered temperature of deformation. In both cases microstructures are dominated by straight joggy screw dislocations. It is felt that a frictional stress composed of an inherent Peierls-Nabarro stress and effects of mismatch in atomic size and modulus increases the resistance to motion of screw dislocations. Electron microstructures of pyrolytic carbon coatings on nuclear fuel particles and were obtained and correlated with physical properties of the coatings. In addition, steps in the graphitization that occur during annealing of massive pieces of pyrolytic carbon were followed. (auth)

44147 (ORNL-3670(p.21-2)) METALLURGY OF SUPERCONDUCTING MATERIALS. M. L. Picklesimer (Oak Ridge National Lab., Tenn.).

The new Superconducting Materials Laboratory was completed and occupied. Almost all of the equipment necessary for the studies of the effects of metallurgical variables on the superconducting properties has been obtained. The glove-box complex designed for the metallurgical study of technetium and its alloys was installed, along with most of the necessary equipment. The transformation kinetics study of the Nb–Zr superconducting alloys has continued, using homogenized materials. The homogenization produced a large grain size and contamination by oxygen and silicon, causing severe cracking during fabrication and affecting the transformation kinetics. The pearlitic transformation ceased 10 to 15 μ from the nucleation site at microscopic defects, such as grain boundaries and slip bands; a second type of transformation consumed the remaining material. In evaluating the superconducting properties of short specimens, one difficulty is making certain that the properties of the specimen are being tested, not those of the joint between the specimen and normal-state current leads. Variables of joint design and manufacture are being investigated. The lowest joint resistances obtained to date range from 1.6 to 1.9 microhm, with a reproducibility of manufacture of only three in four. (auth)

44148 (ORNL-3670(p.23-6)) PHYSICAL PROPERTIES. D. L. McElroy (Oak Ridge National Lab., Tenn.).

The study was continued of accurate methods of measuring the thermal conductivity, k, and other physical properties of solids over a broad temperature range to improve the understanding of heat transfer mechanisms. The mea-

surements on UO_2 showed that the observed maximum in k at room temperature is explained by the rapid decrease in specific heat. The thermal resistance, 1/k, was linear between 200 and 1000°C, as expected for pure phonon conduction in an insulator above its Debye temperature. The temperature dependence of k of Armco iron was largely controlled by the electronic contribution, but a 4% decrease in k at the α-γ transformation was due to a 20% decrease in the lattice contribution to the thermal conductivity. By the thermal comparator method, k was measured at 75 and 300°C for US, ThS, and UN; with auxiliary measurements and theory, reasonable extrapolations were made to 1000°C. A technique was perfected to measure the total hemispherical emittance of conductors to 1500°C, and the emittance and electric resistivity of a number of refractory metals and alloys were measured. (auth)

44149 (ORNL-3670(p.36-43)) STRUCTURE OF METALS. C. J. McHargue (Oak Ridge National Lab., Tenn.).

Studies on preferred orientation and inhomogeneous deformation were continued on face-centered cubic metals. While swaging, extruding, and drawing of aluminum rod all resulted in duplex ⟨100⟩-⟨111⟩ fiber textures, the proportions of the components were significantly different. Specimens of fine-grained, randomly oriented aluminum and copper developed the same texture when extruded at room temperature. Preliminary results showed that the dislocation velocity varies as the eighth power of stress in zone-refined niobium. The exact value of the exponent was very sensitive to impurities. Details of an unusual non-steady-state grain growth occurring in early stages of annealing in aluminum were studied, and a model based on interactions between point defects and grain boundaries is proposed. Annealing of deformation twins in niobium single crystals showed that the twins can either contract or expand by the migration of noncoherent twin boundaries. Recrystallization occurred at 1000°C at twin intersections. (auth)

44150 (ORNL-3670(p.44-53)) THEORY OF ALLOYING. J. O. Betterton (Oak Ridge National Lab., Tenn.).

A study was made of the galvanomagnetic properties at 4.2°K of high-purity single crystals of zirconium and beryllium with the current directions $[2\bar{1}\bar{1}2]$ and $[3\bar{1}\bar{2}2]$, respectively, in steady magnetic fields to 31 kilogauss. Both metals showed anisotropy and field dependence characteristic of even-valent metals with equal numbers of holes and electrons and with closed sections of the Fermi surface. Transverse even properties indicated that the Fermi surfaces of both metals were open in certain directions. The low-temperature specific heats of the continuous hafnium–zirconium solid solution showed that the density of electronic states and the Debye temperatures are nearly linear with composition. However, in the similar titanium–zirconium solid solution a maximum in density of states occurred at 0.6 Ti–0.4 Zr, and corresponding maxima occurred in superconductivity and in electric resistivity. This maximum is not due to long-range order of the atoms. A variation typical of random solid solutions occurred in the electrical resistance. The low-temperature specific heats of the continuous solid solution of the system scandium–zirconium and of dilute solid solutions of niobium and molybdenum in zirconium were measured. The density of electronic states showed a minimum at 0.9 Zr–0.1 Sc and rose to a high value for pure scandium. Superconductivity was absent at 1.2°K in scandium and zirconium–scandium alloys. The drop in density of states in zirconium with additions of scandium was approximately equal and opposite to the effect of silver. The additions of molybdenum and niobium produced much larger effects on the density of states than silver and were accompanied by large increases in superconducting transition temperature. The electrical resistivity of alpha–zirconium increased slightly with dilute additions of niobium. The Mössbauer spectrum of aluminum alloys with dilute cobalt additions showed significant changes in these alloys during precipitation heat treatment. (auth)

44151 (ORNL-3670(p.129-31)) REACTIONS IN SOLIDS. T. S. Lundy (Oak Ridge National Lab., Tenn.).

It was found that Arrhenius-type expressions adequately describe the temperature variations of volume diffusion coefficients in niobium and tantalum but not in β-zirconium, β-titanium, or vanadium. Bombardment with 10^{11} 2.2-Mev alpha particles per square centimeter per second increases diffusion coefficients of lead in silver single crystals by 6×10^{-18} cm^2/sec in the temperature range of 360 to 480°C. The thermal-gradient redistribution of antimony in silver can be described in terms of a kinetic theory and an unusually large negative heat of transport ($Q^* = -29 \pm 3$ kcal/mole). (auth)

44152 (ORNL-3670(p.142-6)) URANIUM NITRIDE. W. C. Thurber (Oak Ridge National Lab., Tenn.).

Uranium mononitride is being evaluated as a fuel for high-temperature reactors with high power densities. Several pertinent physical properties, including coefficient of thermal expansion, electric resistivity, thermal conductivity, and fission-gas release after neutron activation, have been measured and are reported. Preliminary measurements of the pressure-temperature-composition relationships in the uranium–nitrogen binary system are described. (auth)

44153 (ORNL-P-425) A SUMMARY OF ORNL WORK ON DIFFUSION IN β–Zr, V, Nb, AND Ta. T. S. Lundy, J. I. Federer, R. E. Pawel, and F. R. Winslow (Oak Ridge National Lab., Tenn.). [1964]. Contract W-7405-eng-26. 25p. (CONF-711-1)

From Symposium on Body-Centered Cubic Materials, Gatlinburg, Tenn., Aug. 1964.

Highlights are presented of several studies of diffusion in body-centered cubic metals. In these studies, tracer methods were used in combination with mechanical sectioning techniques. The diffusion of ^{95}Zr and ^{95}Nb in β-zirconium, ^{48}V in vanadium, ^{95}Nb and ^{182}Ta in niobium, and ^{95}Nb and ^{182}Nb in tantalum was studied. Deviations from Arrhenius behavior were found in all cases. (D.L.C.)

44154 (SC-DC-64-348) BASIC BEHAVIOR OF FERROELECTRIC MATERIALS UNDER EXPLOSIVELY INDUCED SHOCK WAVES. Final Report. Donald G. Doran (Stanford Research Inst. Poulter Labs., Menlo Park, Calif.). Nov. 30, 1962. For Sandia Corp., Albuquerque, N. Mex. Contract [AT(29-1)-789]. 89p.

The shock compression of the ceramics, $BaTiO_3$(5% $CaTiO_3$) and $Pb(Zr_{0.95}Ti_{0.05})O_3$ (1 wt.% Nb_2O_5), was measured in the range 5 to 200 kb and 2 to 140 kb, respectively. Barium titanate exhibits a two-wave structure above 30 kb, the first wave having a velocity of 6.27 mm/μsec. The cusp in the Hugoniot at 30 kb is interpreted as a dynamic elastic limit. Comparison of the first wave velocity with the measured longitudinal sound speeds of the tetragonal (ferroelectric) and cubic (paraelectric) phases (5.4 and ~6.2 mm/μsec, respectively) suggests, along with other evidence, that the material transforms to the cubic phase in the neighborhood of 7 kb. Below 7 kb subsonic velocities are observed and it is speculated that this phenomenon is associated with domain switching. The particular lead

zirconate composition studied has a two-wave structure above about 40 kb, the position of the cusp in the Hugoniot depending sensitively on initial density. This cusp is presumably the Hugoniot elastic limit. A weak cusp is observed at about 2 kb and a possible cusp at 140 kb. The wave velocity is essentially sonic below 2 kb and subsonic above 2 kb, increasing to about sonic in the neighborhood of 40 kb. A phase transition at 140 kb is suggested. (auth)

44155 (UCRL-10942) SEMICONDUCTING REGION OF BISMUTH I. P. C. Souers and G. Jura (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley. Dept. of Chemistry). Sept. 1963. Contract W-7405-eng-48. 13p.

Measurements of the electric resistance were made on bismuth I between 15 and 35 kilobars at temperatures between 77.4 and 120°K. Above about 150°K, the temperature coefficient of resistance is positive as in a metal. Below 150°K, the coefficient becomes negative as is characteristic of semiconductors. Using the exponential resistance formula, the energy gap on the basis that bismuth is a semiconductor is found to be 0.006 ev at 15 kbars with a steady rise to 0.018 ev at 35 kbars. At higher pressures, bismuth I transforms into a metallic modification with the normal temperature dependence of the resistance. The energy gap in bismuth I is not visible at room temperature because thermal excitation populates the conduction band and yields metallic behavior. (auth)

44156 (UCRL-11418) SLIP MECHANISMS IN SINGLE CRYSTALS OF HEXAGONAL CLOSE-PACKED PHASES. John E. Dorn and Jack B. Mitchell (California. Univ., Berkeley. Lawrence Radiation Lab.). [1963]. Contract W-7405-eng-48. 104p. (CONF-710-1)

From 2nd International Symposium on Materials, Berkeley, Calif., June 1964.

Hexagonal metals and alloys do not have high strength because their ductility is so low. In order to increase the ductility, an adequate number of operative slip systems must be provided. A survey is presented of the knowledge on dislocation mechanisms of slip on each of several slip systems in hexagonal close-packed metals and alloys. The possibilities of producing high-strength hexagonal close-packed alloys are discussed. (D.L.C.)

44157 (UCRL-11520) STRUCTURE AND STRENGTH OF SOME AUSFORMED STEELS. G. Thomas, D. Schmatz, and W. Gerberich (California. Univ., Berkeley. Lawrence Radiation Lab.). June 1964. Contract W-7405-eng-48. 78p. (CONF-710-2)

From 2nd International Symposium on Materials, Berkeley, Calif., June 1964.

A study was made of the mechanism of strengthening of ausformed steels. Alloys of the basic composition Fe–25 Ni–0.3C, which remains austenitic at room temperature but which can be quenched to martensite, were used to examine the strengthening of deformed metastable austenite. It is concluded that: Carbon is essential for hardening of martensite and forms precipitates during deformation of metastable austenite. Deformation in ausforming increases the diffusivity of alloy carbide formers and also contributes dislocations and precipitates to the strengthening action. Dispersions also increase the strengthening. The absence of much transformation twinning may explain the increase in ductility. Macroscopic factors such as martensite grain size do not contribute to the strength of ausformed martensites. (D.L.C.)

44158 (UCRL-11588) SOME FUNDAMENTAL CONSIDERATIONS IN DESIGN OF HIGH-STRENGTH METALLIC MATERIALS. Victor F. Zackay and Earl R. Parker. Appendix by J. Friedel (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1964. Contract W-7405-eng-48. 50p. (CONF-710-3)

From 2nd International Symposium on Materials, Berkeley, Calif., June 1964.

The problem of obtaining high strength with substantial ductility is reviewed from several different viewpoints. The theoretical strength of the structural metals is first estimated and then compared with obtainable strengths. The superiority of certain metals is rationalized in terms of dislocation theory and microstructure. Several processes for increasing the strength of steel while retaining adequate ductility are described. The limitations of strength in alloy systems that undergo precipitation by heterogeneous nucleation are summarized. Further increases in strength and ductility are suggested by the utilization of phase transformations involving homogeneous nucleation. (auth)

44159 (WAL-TR-834.2/11-3) THE FLOW AND FRACTURE OF ZONE-REFINED TUNGSTEN. Final Report. G. J. London (Franklin Inst. Labs. for Research and Development, Philadelphia). Apr. 1964. Contract DA-36-034-ORD-3747 RD. 31p. (F-B1973)

Efforts were made toward the purification of tungsten by induction floating zone melting. The difficulties encountered in initial melting efforts were poor visibility and inadequate zone length control. The former was overcome by using a preliminary solid state vacuum outgassing treatment. The latter difficulty was partly solved with the use of a levitation type melting coil to support the molten zone. Tensile specimens were prepared by spark and chemical machining techniques. Specimens were tested with three electron beam zone passes, one induction zone pass, and three electron beam followed by four induction zone passes. The critical resolved shear stresses decreased in the order listed above, with the one induction zone pass material showing lower CRSS than the three electron beam zone pass material. The tensile results are considered encouraging, but the relatively poor induction zone melting conditions attained prevented a full evaluation of this process. (auth)

44160 (WAPD-TM-432) THERMAL STABILITY EVALUATION OF ELASTOMERIC SEAL MATERIALS. R. E. Moore (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). July 1964. Contract AT(11-1)-Gen-14. 19p.

The thermal stability of the following synthetic rubbers was experimentally determined: silicone, ethylene-propylene (EPR and EPT), nitrile (NBR), styrene (SBR), butyl, acrylic, and urethane. These elastomers were tested in air, water, and steam atmospheres over a 150 to 550°F temperature range for 1000 hours with interim inspections at 100, 250, and 500 hours. Triplicate test specimens were evaluated by visual examination and weight and hardness changes. Halide and sulfur contents of the elastomers were also obtained by chemical analyses. Silicone rubber was found to be best in air (stable to 500°F), while the ethylene-propylene rubbers (EPR and EPT), were the most resistant to water (400–450°F) and steam (450–500°F). These two classes of elastomers were clearly superior to the other materials tested and also showed acceptably low halide contents. Silicone and the EP rubbers should meet virtually all non-metallic seal applications in air and water or steam respectively at temperatures below 450 to 500°F. The upper continuous temperature limits of stability for all elastomers tested are listed. (auth)

44161 (AERE-Trans-1009) THERMODYNAMICS OF PHASE TRANSFORMATIONS IN TERNARY SYSTEMS. PARTS I AND II. E. Rudy. Translated by E. Towndrow (U.K.A.E.A., Atomic Energy Research Establishment, Harwell, Berks, Eng.), from Z. Metallk., 54: 112-22; 213-23(1963). 58p.

Part II appears in NSA, 17: 22205.

The question of whether equilibria in three-component systems can be predicted from thermodynamic data and vice versa is considered. Two- and three-phase equilibrium conditions in ternary systems are derived, and particular solutions for model examples are discussed. Equilibria in several metal A–metal B–carbon systems are evaluated thermodynamically. The possibility of calculating energies of formation from experimental phase equilibria is discussed. (D.L.C.)

44162 SIGMA PHASE PRECIPITATES IN Mo–Re ALLOYS. K. Ogawa and R. Maddin (Univ. of Pennsylvania, Philadelphia). Acta Met., 12: 1161-5(Oct. 1964).

Sigma phase precipitates in a Mo–35 at. % Re alloy were studied by transmission electron-microscopy; the habit plane of the precipitates and the orientation relation between the precipitates and matrix was determined. The shape of a sigma phase precipitate in Mo–Re alloys is platelet. The habit plane of sigma phase precipitates is {110} of the matrix. The orientation relation between the precipitate and matrix is that ⟨100⟩ of the precipitate is parallel to ⟨100⟩ of the matrix. The edges of the platelet precipitate were found to be along ⟨111⟩ of the matrix. More patterns were observed in thin precipitates and the electron diffraction reflections from the (hk0) plane of the sigma phase is missing when the sum of the indices h and k is odd. This implies the existence of a diagonal glide plane normal to the tetrad axis of the sigma phase. (auth)

44163 REACTIONS WITH SINGLE CRYSTALS OF NIOBIUM OXIDES. R. Gruehn, F. Schulte, and H. Schaefer (Universität, Munster, Ger.). Angew. Chem. Intern. Ed. Engl., 3: 634-5(Sept. 1964).

Annealing effects on niobium oxide single crystals are discussed. It was found that the behavior of single crystals enables transformation relationships to be recognized that can yield information concerning structural relationships between allied substances. (P.C.H.)

44164 EMISSION AND REFLECTION FACTORS OF SINTERED BERYLLIUM OXIDES. F. Cabannes and Ch. Cabannes (CNRS, Bellevue, France). Ann. Phys. (Paris) (13), 9: 133-8(Mar.-Apr. 1964). (In French)

Four samples of sintered beryllium oxide, differing in grain size, apparent density, and color, were used to study the emission and reflection factors. The mode of reflection of the different frits was determined for several infrared radiations. The reflection spectra of these frits were measured, and the emission spectra were calculated. The parameters affecting the emission factors, such as reflection band, surface state, or temperature, were studied. (J.S.R.)

44165 THE EFFECT OF MOLYBDENUM, TUNGSTEN AND NIOBIUM ON THE STRESS-RUPTURE BEHAVIOR OF ALLOYS WITH ULTRA HIGH STRENGTH AT ELEVATED TEMPERATURES CONTAINING 20% Co, 20% Cr AND 20% Ni. Heinz Gunther Brandt and Klaus Beuscher. Arch. Eisenhuttenw., 35: 447-58(May 1964). (In German)

Investigations were made on alloys containing 0.02 to 0.45% C, 20% Cr, 20% Ni, 20% Co, 0 to 4% Mo, 0 to 4% W, and 0 to 4% Nb by stress-rupture tests at 650 to 750°C, by microscopic techniques, and by x-ray analysis. The effect of Mo, W, and Nb on stress-rupture characteristics was studied. (Rev. Metal Lit., 21: No. 9, Sept. 1964)

44166 THE ABSORPTION SPECTRA OF GOLD HYDRIDE AND GOLD DEUTERIDE IN THE FAR ULTRAVIOLET. Ulf Ringstroem (Universitet, Stockholm). Arkiv Fysik, 27: 227-65(1964).

The absorption spectra of gold hydride (AuH) and gold deuteride (AuD) were studied at 2200 to 3000 Å. In AuH were found 12 new vibrational levels, in AuD, nine. These belong to 5 electronic states: $B0^+$ ($B^1\Sigma^+$ or $^1\Sigma^{**}$), $C^1\Sigma^+$, a2, b1, and $c0^-$. The last four have Hund's case c (far nuclei case c) coupling of the angular momenta. They have large internuclear distances and small dissociation energies. The transition $c0^- \rightarrow X^1\Sigma^+$ was found only in AuH. Such a transition is, just as $2 \rightarrow {}^1\Sigma^+$, usually forbidden. It appears because of rotational uncoupling of electronic angular momenta. The $B0^+$ state is strongly perturbed by $C^1\Sigma^+$, and is also perturbed by b1. Many of the levels are predissociated by an unstable 1 state. The dissociation energy of the ground state of AuH is estimated to be $D_0^0 = 26{,}000 \pm 1000\ cm^{-1}$ (3.22 ± 0.13 ev). The derived constants are shown, together with those of the two lowest electronic states. The electron configuration for the ground state is KLMNOspd $(6s\sigma)^2$, or, shortly, $(d^{10})(6s\sigma)^2$. It is proposed that the first excited state, $A0^+$, belongs to $C^1\Sigma^+$, and that $A0^+$, $B0^+$, a2, b1, and $c0^-$ have configurations of the type $(d^9)(s\sigma)^2(p\sigma)$. The electrons in the (d^9) group are strongly bound together, and designations such as σ, π... lack physical significance for them, but formally the configuration $(d\sigma)^2(d\pi)^3(d\delta)^4(s\sigma)^2(p\sigma)$ is proposed for a2, b1, $c0^-$, and $B0^+$. (auth)

44167 PHYSICO-CHEMICAL PROPERTIES OF URANIUM DIOXIDE (UO_2). E. H. P. Cordfunke. Atoomenergie Haar Toepassingen, 6: 143-9(July 1964). (In Dutch)

The International Atomic Energy Agency organized a panel on the correlation of thermodynamic and transport properties of UO_2 phases. The conclusions on thermodynamic data, phase diagrams, structure of the cubic phase, behavior of UO_2 above 1600°C, surface phenomena, and transport properties are summarized. (J.S.R.)

44168 MEASURING THE ELECTRICAL CONDUCTIVITY OF FLUXES IN THE TEMPERATURE RANGE OF 1300 TO 2300°C. V. N. Kolisnyk. Avtomat. Svarka, No. 4, 10-14(1964). (In Russian)

Tests were made on the wear resistance of electroslag welding cells made of TiC, TiB_2, ZrC, ZrB_2, W_2B_5, CrB_2, Mo, W, and Ir in contact with various molten fluxes during electroslag welding from 1300 to 2300°C. The electric conductivity of various fluxes was determined as a function of FeO concentration in the flux and welding temperature. Selection of optimum materials for electroslag welding cells and optimum chemical composition of the flux to provide for a stable welding process is discussed. (Rev. Metal Lit., 21: No. 8, Aug. 1964)

44169 SOME TEMPERATURE EFFECTS ON POSITRON ANNIHILATION IN METALS. I. K. MacKenzie, G. F. O. Langstroth, B. T. A. McKee, and C. G. White (Dalhousie Univ., Halifax, Nova Scotia). Can. J. Phys., 42: 1837-46(Oct. 1964).

The angular correlation of gamma rays from two-quantum positron annihilation was investigated in seven metals–Zn, Cd, In, Pb, Sn, Al, and Bi–over a range of temperatures from –150°C up to their melting points. The distributions for Pb, Sn, Al, and Bi show no more than the small variation with temperature expected because of the change in lattice volume. Zn, Cd, and In display a large increase in the proportion of annihilations occurring with

the valence electrons at higher temperatures. This observation and evidence of increased thermal scattering correspond to features reported for the solid–liquid transition. Consequently, it is suggested that these three metals exhibit some of the disorder properties of their liquid state as they are heated above room temperature. In addition to the continuous temperature dependence observed for these metals evidence of a small discontinuous change in the distribution for Zn was found. This occurs at a temperature midway between previously reported anomalies in the properties of Zn. (auth)

44170 QUASI-POSITRONIUM IN METALS. A. Held and S. Kahana (McGill Univ., Montreal). Can. J. Phys., 42: 1908-13(Oct. 1964).

A variational search is made for a quasi-bound state of an electron–positron pair in a metal. The basic equation used is the effective Schrödinger equation derived from the electron–positron propagator in an approximation which accurately accounts for the two-body correlations. It is found that no such state exists in metals, and hence it can have no influence on the positron annihilation rates. However, the state appears for electron gases of sufficiently low density and thus determines the low-density annihilation rates. (auth)

44171 EXCHANGE CORRECTIONS AND THE CONVERGENCE OF THE PERTURBATION EXPANSION FOR THE MOMENTUM DISTRIBUTION FUNCTION FOR AN INTERACTING ELECTRON GAS AT METALLIC DENSITIES. D. J. W. Geldart, A. Houghton, and S. H. Vosko (McMaster Univ., Hamilton, Ont.). Can. J. Phys., 42: 1938-68(Oct. 1964).

The ground-state momentum distribution of an interacting electron gas at metallic densities is investigated using many-particle perturbation theory. Approximation methods and computational techniques are developed for the evaluation of the leading exchange corrections to the random phase approximation. It is concluded that the straightforward perturbation expansion, which includes only single direct and exchange self-energy insertions, does not converge at the lower metallic densities and that it is necessary to include "higher-order" effects by renormalizing the electron propagator. When this is done, a large gap at the Fermi surface remains in the momentum distribution. (auth)

44172 THE ADSORPTION OF HELIUM BY CARBONACEOUS SOLIDS. K. A. Kini and W. O. Stacy (Commonwealth Scientific and Industrial Research Organization, Chatswood, Australia). Carbon, 1: 17-24(Oct. 1963).

The adsorption of helium by graphite, active carbon, carbon black, cokes, coals, and other carbonaceous solids was studied at temperatures from 77 to 560°K. Adsorption at 298°K depends markedly on the nature of the material, and in general increases with increasing internal surface area and increasing true density. At low temperatures some carbons, such as brown coal char and carbon black, adsorb strongly; others, such as certain vitrains and low-temperature coke, adsorb weakly at all temperatures studied, and may even show an apparent negative adsorption below 200°K. The latter effect is attributed to closure of the pores by thermal contraction. The isosteric heats of adsorption on active carbon increase from about 0.6 kcal/mole at 85°K to about 3 kcal/mole at 400°K. Following the theory of De Boer and Kruyer, it is suggested that the electrical conductivity of the carbon has an important influence on its adsorptive capacity for helium. The accuracy of determination of the true density of high-density carbons by helium displacement at room temperatures can be seriously affected by adsorption of the helium. (auth)

44173 MECHANICAL ENERGY LOSSES DUE TO MOTION OF DISLOCATIONS IN GRAPHITE AND CARBONS. T. Tsuzuku (State Univ. of New York, Buffalo). Carbon, 1: 25-32(Oct. 1963).

By means of an electromagnetic driving and detection system investigations of mechanical energy losses under alternating stress were performed on various carbon solids. Materials studied were a glassy carbon, various baked carbons, polycrystalline graphites, and some pyrolytic graphites. It was found that with decreasing strain amplitude the internal friction Q^{-1} decreases and the dynamic elastic modulus E increases towards limiting values Q_0^{-1} and E_0. Moreover, the amplitude dependent portion of the internal friction $Q^{-1} - Q_0^{-1}$ is linearly proportional to the modulus defect $(E_0 - E)/E_0$ for the same amplitude. A very weak neutron irradiation (dose less than 10^{14} nvt) causes in some cases very large changes in the loss character. These facts can be explained by point imperfections pinning down dislocations. The temperature dependence of Q_0^{-1} for polycrystalline graphite shows a so-called Bordoni peak at 50°K for a frequency of about 12 kc accompanied by a small hump at 80°K. The curve of E_0 against temperature shows steep drops in the same ranges of temperature. The Peierls potentials of the glissile dislocations in graphite corresponding to these two peaks are roughly estimated to be 0.07 and 0.12 ev, respectively. (auth)

44174 STUDIES OF YOUNG'S MODULUS OF CARBONS AT HIGH TEMPERATURE. J. F. Andrew and S. Sato (State Univ. of New York, Buffalo). Carbon, 1: 225-34(Apr. 1964).

Preliminary results of measurements of the static Young's modulus for carbons at high temperature were reported previously. Since that time the apparatus was improved in reliability and in reproducibility. As previously the deflection of a specimen heated in a graphite tube furnace was obtained from deflections measured at three points using Linear Variable Differential Transformers; however in the new equipment the corresponding electronic circuits were greatly modified. The force-deflection curves were obtained directly on an X–Y recorder. With this improved apparatus the following studies were carried out: dependence of Young's modulus on temperature for four basic types of carbons heat treated to 3000°C (soft filler-soft binder, soft filler-hard binder, hard filler-soft binder, and hard filler-hard binder); complete systems of temperature dependence curves for these four types of carbons and for glassy carbon were obtained as these carbons were progressively heat treated to higher temperatures and then cooled back to room temperature; dependence of Young's modulus on temperature was measured for pyrolytic graphite and ZTA graphite. It was found that for soft filler materials all curves of Young's modulus vs temperature show a maximum below the heat-treatment temperature. Hard filler bodies show a continuous decrease in modulus with increase of temperature. ZTA and pyrolytic graphite behavior is similar to that of soft filler bodies, whereas glassy carbon is similar to hard filler materials. (auth)

44175 ORIGIN OF ETCH PITS ON GRAPHITE SURFACES. Glenda Hughes (University Coll. of North Wales, Bangor, U. K.), J. M. Thomas, H. Marsh, and R. Reed. Carbon, 1: 339-43(Apr. 1964).

The production of etch pits on the basal planes of graphite by oxidizing gases is likely to be due to the presence in the graphite lattice of a variety of defects, the most important of which are line dislocations (edge and screw), impurities as such, condensed point defects, or a combination of these. Results obtained using optical and electron micro-

scope studies of oxidized Ticonderoga graphite crystals are critically assessed in the light of current views regarding the nature of defects in graphite to examine which of the various agencies are likely to be the most important in stimulating the production of etch pits. Evidence is presented to show that condensed vacancy loops and c-axis screws, separately, stimulate pit formation. (auth)

44176 RAPID METHOD OF MEASUREMENTS OF ELASTIC PROPERTIES OF GRAPHITE BY MEANS OF FLEXURAL SONIC WAVES. R. Mendez-Peñalosa and J. L. Otero (Junta de Energia Nuclear, [Madrid]). Carbon, 1: 425-8(July 1964).

A method is presented for determining the Young's modulus of graphite based on the measurements of the resonance frequency of flexural waves in cylindrical samples. Equations are given for computing Young's modulus using Goen's solution to Timoshenko's differential equation for flexural vibration of a bar with free ends. Samples of graphite with different ratios of radius of gyration to the length of the sample were examined in an effort to determine the optimum geometry for obtaining suitable excitation of the flexural waves. The resonance frequency of flexural wave versus density of graphite is presented for parallel and perpendicular direction relative to the extrusion axis. (auth)

44177 DETERMINATION OF THE THERMAL DIFFUSIVITY FOR POLYCRYSTALLINE GRAPHITES AS A FUNCTION OF TEMPERATURE. N. H. Juul (State Univ. of New York, Buffalo). Carbon, 1: 503-9(July 1964).

The steady sinusoidal technique employed previously to determine the thermal diffusivity in carbons was improved and its temperature range extended. In this technique a sinusoidal heat input occurs at one end of a thin walled tube placed in a uniformly heated container and the variation in temperature was observed at various points along the tube. Measurements of the longitudinal diffusivity were performed in the temperature range 40 to 1200°C on various types of carbons graphitized at about 2800°C. (auth)

44178 MECHANICAL DAMPING IN CARBON AND GRAPHITE AT LOW TEMPERATURE. T. Tsuzuku (State Univ. of New York, Buffalo). Carbon, 1: 511-14(July 1964).

The mechanical damping of polycrystalline graphite, pyrolytic graphite, and glassy carbon was investigated using the longitudinal resonance-bar technique in the temperature range from 300 down to 20°K. The presence of the so-called Bordoni peaks in internal friction at 50 and 75°K was reconfirmed for polycrystalline graphite. In addition, a broad peak was found at around 220°K. Two weak peaks were found in internal friction for pyrolytic graphite at around 75 and 215°K, and some structure was observed in the curve for glassy carbon, but not sufficient for drawing any definite conclusion. It was also found that the strain amplitude dependence of internal friction does not become appreciable until a pyrolytic graphite is heat treated well above 3000°C. (auth)

44179 OPTICAL AND LUMINESCENCE CHARACTERISTICS OF NEODYMIUM-ACTIVATED GLASS. K. Hauptmanova, J. Pantoflicek, and K. Patek (Inst. of Physics, Prague and Charles Univ., Prague). Czech. J. Phys., 14: 698-706(1964). (In German)

The absorption and emission spectra and the luminescence kinetics of Ba glass activated with Nd were measured. The spectrum of Nd^{3+} was interpreted from the term-scheme of free Nd^{3+}. The use of such glass in laser techniques is discussed. (auth)

44180 INVESTIGATION OF Cr–Nb–Mo SYSTEM. V. M. Svechnikov and G. F. Kobzenko. Dopovidi Akad. Nauk Ukr. RSR, No. 4, 492-8(1964). (In Ukrainian)

The preparation of Cr–Nb–Mo alloy specimens of alternating composition by induction melting of high purity components, argon annealing, and water quenching is described. X-ray, thermal, microscopic, and dilatometric analyses used for plotting of constitutional cross sections in the temperature range from 1000 to 2000°C. (Rev. Metal Lit., 21: No. 9, Sept. 1964)

44181 HEXAGONAL LAVES PHASES IN THE ALLOYS OF MAGNESIUM WITH RARE-EARTH METALS. P. I. Krypyakevich, V. I. Evdokimenko, and I. I. Zalutskii (Lvov State Univ.). Dopovidi Akad. Nauk Ukr. RSR, No. 6, 766-9 (1964). (In Russian)

By means of x-ray diffraction, the compounds RMg_2 (R = Eu, Th, Er, Yb, or Y) with a structure of the $MgZn_2$ type were found. (auth)

44182 EFFECTS OF THE DIFFUSION OF OXYGEN AND CARBONIUM ON THE MORPHOLOGY OF ZIRCALOY-2. A. Bassi and G. Camona (Laboratori CISE, Milan). Energia Nucl. (Milan), 11: 444(Aug. 1964).

Morphologic phenomena due to the diffusion of carbonium and oxygen in Zircaloy-2 observed during metallographic experiments are reported. One group of samples underwent treatment at about 900°C; a second group was treated at a temperature higher than 1000°C. In the first group of samples, grains with clear α morphology were observed in the area more concerned with the diffusion, while the remainder of the sample showed a Widmanstatten type grain. In the second group of samples the phenomenon observed was more complex. The presence of a layer, close to the surface, with α type basaltic grains was observed. (P.C.H.)

44183 THE CANADIAN EXPERIENCE WITH METALLIC COMPONENTS OF NUCLEAR REACTORS. F. H. Krenz (Atomic Energy of Canada Ltd., Chalk River, Ont.). Energia Nucl. (Milan), 11: 514-18(Sept. 1964). (In Italian)

The properties and behavior of some cladding and structural alloys (particularly Al–Mg and Zircaloy) are briefly discussed. (D.C.W.)

44184 HALL EFFECTS IN GADOLINIUM AT 4.2 TO 370°K. N. V. Volkenshtein and G. V. Fedorov (Inst. of Metal Physics, Academy of Sciences, USSR). Fiz. Metal. i Metalloved., 18: 26-30(July 1964). (In Russian)

Measurements were made of the Hall effects, specific electric conductivity, and magnetization of high purity ($\rho_{293°K}/\rho_{4.2°K} = 51$, $\rho_{4.2°K} = 2.4$ μohm · cm) gadolinium, and the data were compared with theory. It was confirmed that the temperature dependence of the Hall coefficient near the Curie point is determined by the temperature dependence of conductivity in the magnetic section. (tr-auth)

44185 PHONON DISPERSION CURVES IN BISMUTH. J. L. Yarnell (Los Alamos Scientific Lab., N. Mex.), J. L. Warren, R. G. Wenzel, and S. H. Koenig. IBM J. Res. Develop., 8: 234-40(July 1964).

Dispersion curves for phonons propagating in the trigonal direction in bismuth at room temperature and at 75°K have been obtained in a neutron inelastic scattering experiment. At room temperature, the observed frequencies were about 1.5 percent lower than at 75°K. Data were also obtained for longitudinal phonons propagating in the binary direction at 75°K. The splitting between the zone-boundary frequencies for the optical and acoustic branches for each polarization is quite large. This splitting is difficult to understand if bismuth is thought of as a slightly distorted simple cubic lattice. The experimental results may be

qualitatively understood if bismuth is considered to be made up of a series of double layers normal to the trigonal axis. The atoms in each double layer form a crinkled hexagonal net with strong, probably covalent, bonds between atoms. The forces between atoms on adjacent double layers are relatively weak. This model is consistent with the easy cleavage of bismuth normal to the trigonal axis. Analysis of the trigonal dispersion curves in terms of a linear chain model indicates that there are significant forces connecting a given atom with atoms situated on the four planes on either side of it. (auth)

44186 ENERGY BAND STRUCTURE OF GRAPHITE. J. W. McClure (Univ. of Oregon, [Eugene]). IBM J. Res. Develop., 8: 255-61(July 1964).

The energy band structure of graphite is described in the region of the Fermi surfaces. The electron and hole Fermi surfaces are highly elongated and are aligned along the six Brillouin zone edges, which are parallel to the trigonal axis of the crystal. The energy is a nonparabolic function of wavenumber and the Fermi surfaces are not ellipsoids. Galvanomagnetic, de Haas-van Alphen, and other experiments have established that: the band overlap is about 0.03 to 0.04 ev; the carrier densities of electrons and holes are each about 3×10^{18} cm^{-3} at low temperatures; the effective masses perpendicular to the trigonal axis are about 0.04 m_0 for electrons and 0.06 m_0 for holes; and the length-to-width ratio of the Fermi surfaces is about 12. The only important effect not included in the model is the correlation of electron motion owing to the Coulomb interaction. Though this effect is expected to be important a priori, it is not yet clear if it causes important discrepancies between the predictions of the model and the experimental results. (auth)

44187 THE FERMI SURFACE OF GRAPHITE. Mildred S. Dresselhaus and John G. Mavroides (Massachusetts Inst. of Tech., Cambridge). IBM J. Res. Develop., 8: 262-7(July 1964).

Magnetoreflection measurements in pyrolytic graphite were interpreted using the magnetic energy levels obtained from a secular equation and the appropriate selection rules for interband transitions. Combining these results with those of the de Haas-van Alphen effect, the band parameters of the energy-band model were evaluated and the Fermi surface determined. The magnetoreflection experiment indicates considerable warping of the Fermi surface, particularly for holes. Further experiments to determine this warping more precisely are discussed. (auth)

44188 CHANGE IN FERMI SURFACES OF GRAPHITE BY DILUTE ACCEPTOR DOPING. D. E. Soule (Union Carbide Corp., [Parma, Ohio]). IBM J. Res. Develop., 8: 268-73(July 1964).

The effect of doping graphite single crystals with the acceptor boron was studied in the dilute range (from $\lesssim 0.1$ ppm to 0.5%) by measurements of the Hall effect and de Haas–van Alphen effect. The transition from a mixed electron and hole conduction in the narrow band overlap region (0.035 ev) to that of a single hole conduction produces a peak in the Hall coefficient that shifts to a lower boron concentration with a decrease in temperature. The increase in hole concentration is accompanied by a rapid decrease in mobility, demonstrating the importance of collision broadening. Preliminary de Haas–van Alphen results tentatively identify the major electron and hole Fermi surfaces by means of the period shift with increasing acceptor concentration. A new, very small, ellipsoid-like Fermi surface was discovered. It is aligned along the hexagonal axis, having an anisotropy ratio of 9 with orbital masses of about 0.0023 m_0 for $H \parallel C$ and 0.017 m_0 for $H \perp C$. Analysis strongly indicates that this surface contains minority holes. Three of these surfaces are considered to be aligned symmetrically like "outriggers" about the major hole surface, producing a total of six in the Brillouin zone. A comparison is made with the cyclotron resonance results and a possible interpretation of these minority Fermi surfaces is presented using an energy band model. (auth)

44189 STRUCTURE-PROPERTY RELATIONS FOR PYROLYTIC GRAPHITE. L. F. Coffin, Jr. (General Electric Co., Schenectady, N. Y.). J. Am. Ceram. Soc., 47: 473-8(Oct. 21, 1964).

The mechanical and physical properties of pyrolytic graphite are closely related to the structure produced during its deposition. It is shown how various features of the deposited structure can be predicted with some accuracy. These features include the structure of isolated nodules, the influence of various substrate conditions, and the effects of continuous nucleation. The effect of these structures on properties is discussed and the relation of the residual stress state to the deposition conditions is explained. (auth)

44190 THERMAL EXPANSION CHARACTERISTICS OF POLYCRYSTALLINE TUNGSTEN OXIDES. Takeshi Takamori (Nippon Electric Co., Tokyo). J. Am. Ceram. Soc., 47: 534-5(Oct. 21, 1964).

Thermal expansion characteristics of WO_2, $W_{18}O_{49}$, $W_{20}O_{58}$, and WO_3 measured dilatometrically are reported. Temperatures and heating times were 950°C for 40 hr, 1000°C for 40 hr, and 1050°C for 80 hr for WO_2, $W_{18}O_{49}$, and $W_{20}O_{58}$, respectively. A small increase in expansion was observed on repeated measurements of WO_2 specimens. Forming pressure had no apparent effect on the expansion characteristics of the oxides. The average coefficients of linear thermal expansion of sintered tungsten oxides were determined to be 3.3×10^{-6} per °C (30 to 350°C) for WO_2; 1.2×10^{-6} per °C (30 to 350°C) for $W_{18}O_{49}$; 0.2×10^{-6} per °C (30 to 350°C) and -0.9×10^{-6} per °C (30 to 500°C) for $W_{20}O_{58}$; 15.3×10^{-6} per °C (30 to 350°C) and 12.5×10^{-6} per °C (350 to 600°C) for WO_3 (sintered at 1100°C). (P.C.H.)

44191 DEFORMATION OF NIOBIUM SINGLE CRYSTALS IN THE RANGE 1400°–2300°C. B. Harris (Cambridge Univ., Eng.). J. Less-Common Metals, 7: 185-96 (Sept. 1964).

A study was made of the deformation of pure niobium crystals during short-time tensile experiments at temperatures between 0.5 T_m and T_m (where T_m is the absolute melting temperature). Crystals were prepared by the electron-beam, floating-zone method, and were deformed under conditions of both constant and differential strain-rate. The results of these experiments were compared with the properties of less pure niobium and with the reported behavior of other bcc metals. The deformation appears to be described by a relationship of the form $\dot{\epsilon} = A\sigma \exp(-\Delta H/RT)$. Calculations of activation energy and activation volume were made, and dislocation mechanisms, which might be responsible for the form of the deformation equation, are discussed. (auth)

44192 DIFFUSION OF GASES IN SPECIAL INTERSTITIAL SITES IN HAFNIUM. E. Bisogni, G. Mah, and C. Wert (Univ. of Illinois, Urbana). J. Less-Common Metals, 7: 197-204(Sept. 1964).

Both nitrogen and oxygen were found to cause internal friction peaks to appear in reactor-grade Hf. The mechanism of the peak is discussed in terms of redistribution of

strain dipoles formed by the interstitial impurity atoms with the substitutional impurity atoms. The diffusion coefficients were calculated from a simple two position model: $D_{oxygen} \simeq 30 \exp(-58{,}000/RT)$ and $D_{nitrogen} \simeq 0.20 \exp(-50{,}000/RT)$. (auth)

44193 THE DEFORMATION OF POLYCRYSTALLINE NIOBIUM AT ROOM TEMPERATURE. A. Wronski and A. Fourdeux (Union Carbide European Research Associates, Brussels). J. Less-Common Metals, 7: 205-11 (Sept. 1964).

A series of experiments on polycrystalline flash-annealed niobium are described, which were designed to relate the room temperature yielding and work-hardening properties to purity and microstructure, as observed by transmission electron microscopy. It was found that, for the same low strain rate, whereas the shape of the load-elongation curve appears to depend markedly on purity, the dislocation density and structure does not and that dipoles, tangles, and eventually cells are formed for all purities of the material studied. Qualitatively and quantitatively the electron microscope results are very similar to some reported earlier for less pure niobium, for iron, and even for face-centered metals, such as copper. The mechanical properties of the purest material resemble those recently found for zone-melted niobium single crystals, namely yield stress of ~3.5 kg/mm^2 and a region of rapid work hardening. Results are discussed in terms of a model in which yielding is governed by the dislocation multiplication and velocity characteristics in the material. A new and surprising feature of the results is the observation that the strain rate, which apparently does not influence the dislocation density, has a pronounced effect on the dislocation arrangement. (auth)

44194 THE EQUILIBRIUM DIAGRAM OF THE SYSTEM MOLYBDENUM–NICKEL. R. E. W. Casselton and W. Hume-Rothery (Oxford Univ.). J. Less-Common Metals, 7: 212-21(Sept. 1964).

The equilibrium diagram of the system molybdenum–nickel was determined by a combination of thermal, microscopical, and x-ray methods. The system contains an intermediate γ-phase whose composition limits include the value corresponding to $MoNi_3$; this phase has an orthorhombic structure. In contradiction to previous work, the composition of the intermediate δ-phase does not include the equiatomic ratio, and has a slight composition range centered at about 47 at. % Ni. The intermediate β-phase has a composition in the region of 80.5 to 81 at. % Ni, and does not include the exact ratio $MoNi_4$; the structure is tetragonal and may be regarded as derived from a $MoNi_4$ superlattice of the fcc Ni solid solution. The lattice spacings of the terminal solid solutions were determined. The equilibrium diagram of the systems Mo–Co and Mo–Ni show many similarities, and these are discussed. (auth)

44195 FRACTOGRAPHY OF POLYCRYSTALLINE MOLYBDENUM. A. Gilbert, W. R. Warke, and B. A. Wilcox (Battelle Memorial Inst., Columbus, Ohio). J. Less-Common Metals, 7: 222-7(Sept. 1964).

In order to investigate the crack initiation sites, several coarse- and fine-grained Mo tensile specimens were fractured at different strain rates at room temperature. The fracture surfaces were then examined by both optical and replica electron microscopy. Fracture of the coarse-grained specimen occurred mainly by cleavage, but occasional grain-boundary facets were observed away from the initiation site. In the case of a fine-grained specimen fractured at a strain rate of 6×10^{-2}/sec, the fracture origin was composed of a group of five or six grain-boundary facets. Both cleavage and grain-boundary facets were found on the same fine-grained specimen, which indicates that fracture occurred by alternating cleavage and grain-boundary crack propagation. (P.C.H.)

44196 DEFORMATION TWINNING OF POLYCRYSTALLINE CHROMIUM–RHENIUM ALLOYS. A. R. Rosenfield (Battelle Memorial Inst., Columbus, Ohio). J. Less-Common Metals, 7: 235-8(Sept. 1964).

During the measurement of twinning stress of Cr–Re alloys, some interesting grain-size effects were uncovered. The most surprising effect was a large negative slope of the line for Cr–35Re. In order to test the effect of the presence of substructure, several deformed samples of about 1/8 mm grain size were annealed to produce dislocation networks. The difference in twinning stress between the two series is on the order of the experimental uncertainty, and it was concluded that grown-in substructure has no substantial effect on the twinning stress of this alloy. Metallographic evidence that deformation twins are generated at precipitates located in grain boundaries was found in Cr–15Re. An important difference between Cr–35Re and Cr–15Re was the complete absence of visible precipitates in the more concentrated alloy. It was concluded that a large positive k_T occurs when an alloy contains grain-boundary precipitates that cause large local-stress concentrations. (P.C.H.)

44197 A CONSTITUTION DIAGRAM FOR THE NIOBIUM–RUTHENIUM SYSTEM ABOVE 1100°C. G. F. Hurley and J. H. Brophy (Massachusetts Inst. of Tech., Cambridge and International Nickel Co., Inc., Bayonne, N. J.). J. Less-Common Metals, 7: 267-77(Oct. 1964).

A constitution diagram is proposed for the system niobium–ruthenium. Solidus, metallographic, x-ray, and diffusion couple data were considered. A minimum melting point, maximum melting point, and eutectic occur in order of increasing ruthenium composition. The minimum melting point occurs at 39 at. % ruthenium and 1870°C, and the maximum at 50 at. % ruthenium and 1942°C. The maximum solubility of ruthenium in niobium is 58 at. %, but the bcc terminal solid solution exists at room temperature only up to 40 at. % ruthenium. From 40 to 58 at. % ruthenium the structure is bct suggesting the existence of a martensitic transformation. The maximum solubility of niobium in ruthenium is 29%. An hcp intermediate phase forms peritectoidally at 1540°C and 75 at. % ruthenium. The eutectic reaction between the terminal solid solutions occurs at 1774°C and 65 at. % ruthenium. (auth)

44198 POSITIONS OF THE CARBON ATOMS IN Fe_6W_6C. Janusz Leciejewicz (Inst. of Nuclear Research, Swierk Research Establishment, Otwock, Poland). J. Less-Common Metals, 7: 318-20(Oct. 1964).

A neutron diffraction study was made of Fe_6W_6C with the aim of determining the positions of the carbon atoms. The results indicate that the carbon atoms are situated in the centers of perfect octahedra built of tungsten atoms with the W-C distance of 2.13 A. The next nearest 4 iron atoms are 3.21 A, at the apexes of a perfect tetrahedron. (P.C.H.)

44199 THE EFFECT OF STRESS ON THE LUDERS BAND VELOCITY IN COLUMBIUM. H. Conrad and G. Stone. J. Mech. Phys. Solids, 12: 139-48(June 1964).

The effect of stress on the Luders band velocity was studied in Nb of two impurity levels at room temperature. The results indicate that the velocity is uniquely dependent on the effective stress, being independent of specimen length, cross-head velocity, the number of fronts, and the long-range internal stress fields associated with the structure. The activation volume as a function of stress derived

from the present tests is independent of impurity content and is in good accord with that derived previously for yielding and flow in Nb, supporting thermally activated overcoming of the Peierls-Nabarro stress as the rate controlling mechanism. (Rev. Metal Lit., 21: No. 8, Aug. 1964)

44200 STUDIES ON CHEMISORPTION OF NITROGEN ON MOLYBDENUM WITH THE FIELD EMISSION MICROSCOPE. Takeo Oguri and Ichiro Kanomata (Tokyo Metropolitan Univ.). J. Phys. Soc. Japan, 19: 1310-12(Aug. 1964).

The microscopic studies of N_2 on Mo were made and compared with the results of the macroscopic studies. The non-dissociative chemisorption ϵ occurs on the crystal planes of average five nearest neighbors, and the ϵ-adatoms increase the work function of these planes as much as 0.5 ev. While the dissociative chemisorption ζ occurs on the planes of four nearest neighbors, and the ζ-adatoms lower the work function slightly, $0 \sim 0.5$ ev. On the planes on which the ϵ and ζ-adsorptions take place contiguously, the values of the work function changes lie between 0 and +0.5 ev. The results for Mo are similar to those for W. (auth)

44201 MOLYBDENUM RESISTS CORROSION AT HIGH TEMPERATURES. Frank B. Nair, Jr. (Climax Molybdenum Co. of Michigan, Inc., Detroit). Mater. Design Eng., 60: 104-5(Oct. 1964).

The resistance of Mo to hot acids, liquid metals, molten glass, and fused salts is discussed, along with its strength at high temperatures. Applications of Mo and its alloys are also included. (P.C.H.)

44202 OXIDATION OF TUNGSTEN-RHENIUM ALLOYS. R. F. Voytovich and V. A. Lavrenko. Metalloved. i Term. Obrabotka Metal., No. 4, 50-1(1964). (In Russian)

The effects of deformation, recrystallization, and chemical composition on the oxidation rate from 500 to 900°C of W-Re powder metallurgy alloys (5 to 20% Re) recrystallized at about 700°C and deformed up to 20% were studied. (Rev. Metal Lit., 21: No. 8, 1964)

44203 CRYSTALLIZATION IN THE Be-Nb SYSTEM. N. D. Nagorskaya, L. V. Molchanova, M. V. Raevskaya, A. V. Novoselova, I. N. Fridlyander, K. P. Yatsenko, and L. K. Rogova. Metalloved. i Term. Obrabotka Metal., No. 6, 12-15(1964). (In Russian)

The preparation of Be-Nb specimens, containing from 0.7 to 58% Nb, by induction melting in argon is described. Analysis was made of solubility, microstructure, phase composition, micro-hardness, and segregations in the case-state and in specimens undergoing cyclic annealing and quenching. (Rev. Metal Lit., 21: No. 9, Sept. 1964)

44204 DECOMPOSITION PRESSURE HYSTERESIS IN THE ZIRCONIUM-HAFNIUM-HYDROGEN SYSTEM. O. M. Katz (Westinghouse Electric Corp., Pittsburgh) and J. Alfred Berger. Nature, 203: 1163-5(Sept. 12, 1964). (WAPD-T-1716)

A previous investigation of the Zr-Hf-H equilibrium system that revealed the presence of hysteresis is discussed. Experimental results show that decomposition pressure hysteresis must be considered when dealing with equilibrium between gases and multi-component alloy systems, hysteresis always involved a region of more than one phase and was most prominent at lower temperatures where diffusion was slowest, no evidence for an interfering surface film was found, and internal factors such as stress and large surface area accompanying a martensitic reaction are prominent in the hysteresis reactions of the Zr-Hf-H system. (C.E.S.)

44205 OXYGEN DIFFUSION IN TUNGSTEN. C. H. Lee (Franklin Inst. Labs., Philadelphia). Nature, 203: 1163(Sept. 12, 1964).

A diffusion coefficient of oxygen in tungsten at 1700°C is deduced from a direct measurement of the variation of oxygen concentration with time of diffusion and compared with previous estimations. (C.E.S.)

44206 LIGHT-WEIGHT HIGH-REFRACTORY ZIRCONIUM DIOXIDE AND ZIRCON. A. N. Gaodu and I. S. Kainarskii (Ukrainian Scientific Research Inst. of Refractory Materials, USSR). Ogneupory, No. 8, 380-2(1964). (In Russian)

The microstructure and thermal properties of light-weight zirconium dioxide and zircon prepared by blistering are described. The ZrO_2 exhibited no shrinkage after 2 hrs at 1750°C. (R.V.J.)

44207 LATTICE DYNAMICS OF TANTALUM. A. D. B. Woods (Atomic Energy of Canada Ltd., Chalk River, Ont.). Phys. Rev., 136: A781-3(Nov. 2, 1964).

The frequency-wave-vector dispersion relation ($\nu(q)$) for lattice waves traveling in the [00ξ], [$\xi\xi$0], and [$\xi\xi\xi$] symmetric directions of tantalum has been measured at 296°K, using methods of neutron inelastic scattering. The results show strong similarities with the previously measured $\nu(q)$ for niobium. The results can be fitted by a Born-von Kármán force model only if very long-range forces are invoked. Because of the peculiar nature of $\nu(q)$, the Debye approximation appears to be better for tantalum than for most other materials. (auth)

44208 DIFFUSION IN GAMMA URANIUM. N. L. Peterson and S. J. Rothman (Argonne National Lab., Ill.). Phys. Rev., 136: A842-8(Nov. 2, 1964).

The diffusion of radioactive Cr, Mn, Fe, Co, Ni, Cu, and Nb tracers in bcc gamma uranium has been measured from 780 to 1080°C, using the thin-layer sectioning technique. The Arrhenius plots are curved at low temperatures; the curvature is not caused by diffusion along grain boundaries or dislocations, or by defects introduced by the β-γ phase transformation. The activation energies and frequency factors calculated from the linear portion of the Arrhenius plots above the bend are very low (12 to 39 kcal/mol, 10^{-4} to 10^{-2} cm^2/sec) and do not agree quantitatively with any theory of impurity diffusion. The motion of Kirkendall markers in a very small chemical concentration gradient indicates that diffusion is by a defect mechanism; considerations of atomic size rule out interstitials as the defects. Co and Fe diffuse very fast ($D \approx 2 \times 10^{-6}$ cm^2/sec at 950°C), indicating a strong Co- (or Fe-) vacancy binding energy, and a high degree of correlation between the directions of successive vacancy jumps. This is substantiated by the acceleration of self-diffusion in γ-U by additions of Co. (auth)

44209 INVESTIGATION OF POLARIZATION OF EXCITON-ANNIHILATION RADIATION IN CdS SINGLE CRYSTALS. O. Goede and E. Gutsche (Humboldt Universität, Berlin and Deutsche Akademie der Wissenschaften, Berlin). Phys. Status Solidi, 6: 511-20(1964). (In German)

An investigation is made of the spectral distribution of the blue emission in CdS single crystals under excitation with ultraviolet light, for the directions of polarization $\perp$ (c-axis) and $\parallel$ (c-axis), between 77 and 295°K. The position of the two principal peaks and the ratio of the peak intensities in the two directions of polarization are plotted as functions of temperature. The angular distribution of

polarization at 90°K is also measured. It is shown that the two peaks can be attributed to the direct radiative annihilation of intrinsic excitons, and the results are discussed in detail on this basis. (auth)

44210 EFFECT OF HEAT TREATING ON THE BEND STRENGTH OF WC–Co CERMETS. V. I. Tumanov, V. F. Funke, Z. S. Trukhanova, T. A. Novikova, and K. F. Kuznetsova. Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 2, 57-60(1964). (In Russian)

The sintering of WC–Co cermets with Co content ranging up to 50% at 1340 to 1490°C followed by quenching from 1000°C and slow cooling after annealing is described. Analysis was made of bend strength and phase composition of the cermets as influenced by Co content, heat treating, and cooling rates. (Rev. Metal. Lit., 21: No. 8, Aug. 1964)

44211 INFLAMMABILITY OF SOME POWDERED MATERIALS. B. G. Arabey, S. E. Salibekov, and Yu. V. Levinskii. Poroshkovaya Met., Akad. Nauk Ukr. SSR, No. 3, 109-13(1964). (In Russian)

Description is given of the techniques and devices for testing of the inflammability in hot air and in contact with induction heating coil of fine powders of metals and compounds. Data are given on inflammation temperatures and the nature of burning of the following powdered elements and compounds: Nb, Zr, Mo, W, Cr, Ti, Ni, Fe, Cu, Ta, B, Mn, Co, Cr3C2, ZrC, NbC, WC, VC, MoC2, TiC, TaC, HfC, TiB2, ZrB2, CrB2, HfB2, B_4C, and SiB_6 in the temperature range of 180 to 1100°C. (Rev. Metal Lit., 21: No. 9, Sept. 1964)

44212 RADIOISOTOPIC INVESTIGATIONS OF DIFFUSION OF TUNGSTEN IN IRON AND IRON–TUNGSTEN ALLOYS. J. Kieszniewski. Prace Inst. Hutniczych, 15: 151-8(1963). (In Polish)

Diffusion of tungsten in Armco iron and iron-tungsten alloys containing 1.48, 3.35, 4.84, and 11.30% W was studied in the 700 to 900°C range, using the absorption method. Thin layers of radioactive isotope ^{185}W were electrolytically deposited on one sample surface. Diffusion annealing was carried out in quartz ampules in vacuum. Determination was made of the values of activation energy and diffusion rate. (Rev. Metal Lit., 21: No. 9, Sept. 1964)

44213 LOW-TEMPERATURE DEFORMATION OF BODY-CENTERED CUBIC METALS. I. YIELD AND FLOW STRESS MEASUREMENTS. J. W. Christian and B. C. Masters (Oxford Univ.). Proc. Roy. Soc. (London), Ser. A, 281: 223-39(Sept. 8, 1964).

Measurements of the tensile yield stress and of the temperature and strain-rate sensitivity of the flow stress are reported for single crystals of niobium and for polycrystalline specimens of niobium, vanadium and tantalum over the temperature range 4.2 to 373°K. The temperature dependences of yield and flow stresses are nearly identical, and the results show that the high yield stresses at low temperatures are attributable mainly to a frictional force opposing the motion of free dislocations. The yield stress is very dependent on the purity of the metal, and the temperature and strain rate sensitivities vary slightly with purity, especially at higher temperatures. At very low temperatures, the stress needed to cause macroscopic deformation at a strain rate of 10^{-4} s^{-1} is about 1% of the shear modulus in all specimens examined. The relation of the results to the interpretation of the parameters in the Hall-Petch equation for the variation of yield stress with grain size is briefly discussed. (auth)

44214 LOW-TEMPERATURE DEFORMATION OF BODY-CENTERED CUBIC METALS. II. MECHANISM OF THERMALLY ACTIVATED FLOW. J. W. Christian and B. C. Masters (Oxford Univ.). Proc. Roy. Soc. (London), Ser. A, 281: 240-57(Sept. 8, 1964).

The experimental results indicate that the dislocation velocity is limited by a thermally activated process, and the parameters of the appropriate rate equation are evaluated. At very low temperatures, the stress derivative of the free energy of activation (the activation volume) is only a few atomic volumes. It is very difficult to explain the magnitude of the low-temperature stress or that of the activation volume if direct dislocation—impurity interactions are responsible for most of the resistance to motion, and it is concluded that there is probably a significant lattice interaction (a Peierls-Nabarro force). The results are compared with the predictions of recent models for the overcoming of the Peierls barrier by the production of double kinks in straight dislocation lines. (auth)

44215 ANOMALIES IN DILUTE METALLIC SOLUTIONS OF TRANSITION ELEMENTS. G. J. Van Den Berg (Kamerlingh Onnes Laboratorium, Leiden). Prog. Low Temp. Phys., 4: 194-264(1964).

Anomalies in the properties of dilute metallic solutions of transition metals at low temperatures are discussed. Electric resistance, magnetoresistance, thermal resistance, thermoelectric power, magnetic properties, Hall effect, specific heat and optical properties are considered. A bibliography of 190 references is included. (C.E.S.)

44216 MAGNETIC STRUCTURES OF HEAVY RARE-EARTH METALS. Kei Yosida (Tokyo Univ.). Prog. Low Temp. Phys., 4: 265-95(1964).

The results of magnetic and neutron diffraction experiments on single crystals of rare-earth metals are discussed. An attempt is made to clarify the origin of the magnetic structures by showing that these structures are closely connected with the Fermi surface of the conduction electrons. It is shown that the magnetic structures found in the rare-earth metals are stabilized by the exchange interaction, which by itself makes a simple screw structure stable, and by the crystalline anisotropy energy. A bibliography of 55 references is included. (C.E.S.)

44217 MAGNETIC TRANSITIONS. C. Domb (London Univ.) and A. R. Miedema. Prog. Low Temp. Phys., 4: 296-343(1964).

Experimental results on the properties of magnetic transitions are analyzed and compared with the theoretical estimates of the simple Ising and Heisenberg models. A bibliography of 120 references is included. (C.E.S.)

44218 THE RARE EARTH GARNETS. L. Neel, R. Pauthenet, and B. Dreyfus (Univ. of Grenoble, France). Prog. Low Temp. Phys., 4: 344-83(1964).

The magnetic properties of the rare earth garnets and the levels of rare earth ions in the garnets are discussed. A bibliography of 93 references is included. (C.E.S.)

44219 THERMAL EXPANSION OF SOLIDS. J. G. Collins and G. K. White (Commonwealth Scientific and Industrial Research Organization, Sydney). Prog. Low Temp. Phys., 4: 450-79(1964).

The theory of thermal expansion of solids is outlined. Experimental methods for determining expansion coefficients are discussed. Thermal expansion of dielectric solids, metals, glass, diamond-structure solids, and superconductors is considered. A bibliography of 111 references is included. (C.E.S.)

44220 THE KINETICS OF COMMINUTION OF SOME REFRACTORY MATERIALS. A. I. Avgustinik, V. Sh. Vigdergauz, V. M. Gropyanov, and G. V. Drozdetskaya.

Soviet Powder Met. Metal Ceram. (English Transl.), No. 2, 95-8(Mar.-Apr. 1963).

The refractory metals and compounds Ni, Ti, NbC, ZrC, SiC, ZrO_2, and Al_2O_3 were studied to determine the comminution rate. The impact strength, thermal expansion, shear modulus, and microhardness were found to influence the dispersion velocity of these materials. (Rev. Metal Lit., 21: No. 9, Sept. 1964)

44221 SOME NEW VIEWS ON THE HOT PRESSING OF REFRACTORY COMPOUNDS. S. Scholz. Soviet Powder Met. Metal Ceram. (English Transl.), No. 2, 170-5 (Mar.-Apr. 1963).

The density of compacts formed by hot pressing and sintering, at temperatures from 1600 to 2600°C, of some refractory compounds, in particular TaC, was determined. The influence of sintering time and temperature and the impurity content of the powder were investigated. (Rev. Metal Lit., 21: No. 9, Sept. 1964)

44222 INFLUENCE OF Mo AND W ON PROPERTIES OF HEAT RESISTANT NICKEL ALLOYS. M. V. Pridantsev, G. V. Estulin, and L. N. Zimina. Stal, No. 4, 349-53 (1964).

Studies were made on the alloying of Ni with 8 to 10% additions of W and Mo. The alloys were quenched and aged at 600 to 900°C, and analysis was made of creep strength, fatigue, ductility, hardness, impact strength, and phase composition as affected by W and Mo concentrations and aging temperatures. (Rev. Metal Lit., 21: No. 8, Aug. 1964)

44223 THE PROPERTIES OF PYROLYTIC ZrC. Myron P. Lepie (Raytheon Co., Waltham, Mass.). Trans. Brit. Ceram. Soc., 63: 431-49(Aug. 1964).

Chemical vapor deposition produces material of very high purity, density, and crystallographic orientation, but zirconium carbide made by this process is too brittle for use as a structural component. However, if the carbide is pyrolytically co-deposited with graphite, there results a refractory of unique strength: at room temperature, in the order of 50,000 to 100,000 psi, and the value increases with increasing temperature. The thermal-shock resistance of the co-deposited material is also exceptional. No damage was found on exposure to a rocket-exhaust flame. (auth)

44224 THERMODYNAMICS OF PLUTONIUM, THORIUM AND URANIUM METALLIC SYSTEMS. Irving Johnson (Argonne National Lab., Ill.). p.171-92 of "[Nuclear Metallurgy. Vol. X. Symposium on Compounds of Interest in Nuclear Reactor Technology." New York, A.I.M.E., 1964].

The available thermodynamic data for metallic systems of thorium, plutonium, and uranium are reviewed. Data for the following systems are given: plutonium with Al, Be, Cd, Ca, Ce, Cu, La, Pb, Fe, Mg, Ru, Ag, Ti, U, Zn, and Zr; thorium with Al, Bi, Mg, Hg, and Zn; and uranium with Ag, Al, Au, Be, Bi, Cd, Fe, Ga, Ge, Hg, In, Mg, Pb, Si, Sn, Tl, and Zn. A new method for the estimation of the entropy of formation of intermetallic compounds is given. (auth)

44225 THERMODYNAMIC PROPERTIES OF THORIUM CARBIDES FROM MEASUREMENTS ON SOLID EMF CELLS. S. Aronson (Brookhaven National Lab., Upton, N. Y.). p.247-54 of "[Nuclear Metallurgy. Vol. X. Symposium on Compounds of Interest in Nuclear Reactor Technology." New York, A.I.M.E., 1964]. (BNL-7883)

Thermodynamic data in the thorium–carbon system were obtained from measurements on solid electrochemical cells at 800-1000°C. The cells employed were of the following types: Th, ThF_4 | CaF_2 | ThF_4, ThC_2, C; Th, ThF_4 | CaF_2 | ThF_4, ThC_2, ThC; and Th, ThF_4 | CaF_2 | ThF_4, $ThC_{0.7}$, Thα. The free energies, entropies, and enthalpies of formation of thorium monocarbide and thorium dicarbide were determined and were compared to results obtained by others. (auth)

44226 RELATION OF CHEMICAL BONDING TO PHASE DIAGRAMS. R. J. Thorn and G. H. Winslow (Argonne National Lab., Ill.). p.283-302 of "[Nuclear Metallurgy. Vol. X. Symposium on Compounds of Interest in Nuclear Reactor Technology." New York, A.I.M.E., 1964].

Although it is commonly recognized that features of a phase diagram are attributable to the nature of bonding between the components, a direct derivation of these features from the various equations obtained from theoretical analyses of chemical binding energies is not usually accomplished. Towards this perspective and objective a scheme is presented to cite the minimum features needed to construct complex phase diagrams, to evolve a basic unit of a diagram, to sketch the theoretical bases available to derive quantitatively this unit from aspects of chemical bonding, and to illustrate the quantitative calculation of phase boundaries in diagram describing temperature vs composition and pressure vs composition. (auth)

44227 CONSTITUTION AND PROPERTIES OF PLUTONIUM MONOCARBIDE. O. L. Kruger (Argonne National Lab., Ill.). p.387-94 of "[Nuclear Metallurgy. Vol. X. Symposium on Compounds of Interest in Nuclear Reactor Technology." New York, A.I.M.E., 1964].

The preparation of plutonium monocarbide by arc-melting and powder methods is discussed. Data from phase studies on arc-melted material were used to construct a partial phase diagram showing the most probable phase boundaries of PuC. The following properties were reviewed: density, hardness, thermal expansion, electrical resistivity, thermoelectric power, vaporization, heat capacity, thermal conductivity, and compatibility. (auth)

44228 ELASTIC CONSTANTS AND THEIR RELATION TO COHESION AND STABILITY IN INTERMETALLIC PHASES. J. F. Smith (Ames Lab., Ames, Iowa). p.397-407 of "[Nuclear Metallurgy. Vol. X. Symposium on Compounds of Interest in Nuclear Reactor Technology." New York, A.I.M.E., 1964]. (IS-859)

The cohesive energy, equilibrium atomic volume, and bulk modulus of elemental metals can at present be calculated on the basis of first principles, and the calculated quantities in most instances will not deviate from experimental values by more than a few percent. Arguments based on the considerations involved in these calculations indicate that the bulk moduli of intermetallic phases can be approximated from the moduli of the constituent elements if the enthalpy of phase formation is not excessive. Available experimental data substantiate the approximation. Theoretical calculations of cohesive energies have not as yet been developed to the point where the relative stability of one crystal structure with respect to another can be predicted. However, theory does indicate which interactions are important to structure stability, and studies of the elastic shear behavior of intermetallic phases provide relevant information. (auth)

44229 NUCLEAR MAGNETIC RESONANCE TECHNIQUES IN THE STUDY OF INTERMETALLICS. Richard G. Barnes (Ames Lab., Ames, Iowa). p.581-606 of "[Nuclear Metallurgy. Vol. X. Symposium on Compounds of Interest in Nuclear Reactor Technology." New York, A.I.M.E., 1964]. (IS-897)

The application of nuclear magnetic resonance (NMR)

methods to the study of intermetallic compounds and systems is reviewed. Information of value to the solid state physicist or metallurgist was obtained from NMR experiments by regarding the multipole moment properties (magnetic dipole and electric quadrupole) of the nucleus as probing the microscopic local environment of the nucleus. This environment is reflected in the effective hyperfine fields that couple with the nuclear multipole moments. In typical intermetallics, contributions to the hyperfine fields arise from the lattice of ion cores, from the local electronic distribution (conduction electrons and/or bonding electrons), and from electrons in partly filled shells on the host ion itself (the ion containing the nucleus in question). In many instances, NMR measures at the microscopic level a quantity identical with or proportional to some quantity measured at the macroscopic level by other methods. In other cases, new information not obtainable by macroscopic techniques is acquired. The typical thermodynamic variables in NMR studies are temperature, pressure, magnetic field strength, and composition. Examples are given to illustrate the contributions of NMR to understanding the magnetic properties of intermetallics, to studying nuclear quadrupole interactions in metallic substances, and to measuring the diffusion of hydrogen in non-stoichiometric transition metal hydrides. (auth)

44230 METHOD OF MANUFACTURING FUEL ELEMENTS FOR NUCLEAR REACTORS. (to Deutsche Gold- und Silber-Scheideanstalt). French Patent 1,214,753. Nov. 9, 1959. Priority date Feb. 4, 1958, Austria.

Porous sinter bodies consisting of UC, PuC, or UC and PuC mixed with Zr, Nb, Th, Mo, W, or Ti carbides and having a pore volume of 3 to 50%, preferably 15 to 30%, were impregnated with metallic Th or Zr. The material thus obtained constitutes a nuclear fuel with a good thermal conductivity and a high radiation and mechanical resistance. (NPO)

44231 MATERIAL FOR NUCLEAR FUEL ELEMENTS THAT IS RESISTANT TO HIGH TEMPERATURES AND METHOD OF PREPARATION. (to Metallwerk Plansee AG). French Patent 1,321,636. Feb. 11, 1963. Priority date Mar. 7, 1961, Austria.

Mixed crystals of UC–ZrC, UC–NbC, or UC–ZrC–NbC containing up to 30 mol % UC were stable at temperatures over 800°C. The mixed crystals were prepared by heating a compacted mixture of the appropriate quantities of either the single carbides or of carbon and U, Zr, and/or Nb or their hydrides at 1800 to 2000°C. Stable high temperature fuels were obtained by dispersing the mixed crystals in a graphite matrix. To retain fission products the carbide particles could be coated with carbon in a fluidized bed prior to dispersing. (NPO)

44232 NUCLEAR FUEL ELEMENT. (to United Kingdom Atomic Energy Authority). French Patent 1,332,431. June 4, 1963. Priority date Aug. 28, 1961, Great Britain.

A fuel element was designed with a duplex jacket, the interior part of which has a weak creep resistance but is an effective barrier against the diffusion of fission products while the exterior part has high creep and corrosion resistance. Examples of duplex jackets are SAP tubes, interiorly coated with worked Al, or Be tubes interiorly coated with compatible Al-alloys, e.g. Al–Zr alloys. (NPO)

Radiation Effects

Refer also to abstracts 43459, 43608, 43777, and 45060.

44233 (AAEC/E-125) FURTHER EXAMINATION OF IRRADIATED HOT-PRESSED BERYLLIUM OXIDE BASED FUEL SPECIMENS. G. L. Hanna (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Aug. 1964. 10p.

The work reported in AAEC/E-106 on the metallographic examination of $(U,Th)O_2$ dispersed in BeO irradiated in a thermal neutron flux is extended. X-ray diffraction studies have demonstrated that strain developed in the matrixes of both coarse and fine dispersions during irradiation was more severe in the fine dispersion. It is thought that in the coarse dispersion it arose from the swelling of fuel particles and in the fine dispersion, from fission fragment damage. The strain was relieved by annealing in the range 1000 to 1350°C and was partly relieved in the coarse dispersion by crushing. Fission gas bubbles were observed in the microstructure of specimens annealed at 1250 and 1500°C after irradiation. (auth)

44234 (AAEC/E-127) THE RELATIONSHIP BETWEEN MICROCRACKING AND MECHANICAL PROPERTIES IN NEUTRON-IRRADIATED BERYLLIUM OXIDE. G. L. Hanna, G. T. Stevens, and B. S. Hickman (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South, Wales). Aug. 1964. 12p.

Beryllium oxide bend test specimens of two grain sizes, 1 to 2 microns and 8 to 35 microns, were irradiated to fast neutron doses of up to 5.6×10^{20} nvt (above 1 Mev) at 75 to 100°C. Specimens were examined by x-ray line breadth (30.0 reflection), modulus of rupture, elastic modulus, open porosity, and lattice parameter measurements. The results show that there is no significant change in mechanical properties up to the dose at which microcracking is first observed i.e., 3.5×10^{20} nvt in the case of the fine grain size material and 1.2×10^{20} nvt in the case of the coarse grain size material. Above these doses the modulus of rupture and the apparent elastic constants fall rapidly. Microcracking occurred at an earlier dose in both materials than would have been expected from earlier work. (auth)

44235 (AAEC/TM-266) AN INVESTIGATION OF THE EFFECT OF NEUTRON ENERGY ON REACTOR DAMAGE IN BERYLLIUM OXIDE. D. L. McDonald (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Aug. 1964. 10p.

The relative displacement damage in BeO caused by fission neutrons and neutrons with energy in the range 20 to 400 kev has been measured. Using ^{235}U converters with different amounts of moderated fast neutron feedback to BeO thermal conductivity specimens, it is found that neutrons in the lower energy range can cause stable damage during a pile temperature reactor irradiation. The experimental results compare favorably with theoretical predictions of displacement damage. (auth)

44236 (ERDE-12/R/62) THE EFFECT OF HIGH-ENERGY RADIATION ON PLASTICS AND RUBBERS. PART 4. POLYCARBONATE. J. H. Golden and E. A. Hazell (Gt. Brit. Explosives Research and Development Establishment, Waltham Abbey, Essex, England). May 8, 1962. 38p. (AD-281748; WAC/138/011)

Some of the effects of electron irradiation of a polycarbonate, both in oxygen and in vacuum, are described. The polymer undergoes main chain scission and no evidence of crosslinking was found. Molecular weights have therefore been measured viscometrically and G (scission values have been determined from the effect of radiation on molecular weight. The changes in mechanical properties of polycar-

bonate, irradiated in vacuum, with increasing radiation dose have been examined in detail. Conventional tensile properties were measured and fracture energies were also obtained using high-speed tensile impact testing. From the results, the effect of molecular weight on these mechanical properties has been elucidated. Radiation leads to chemical changes which cause enhanced ultraviolet light absorption and the relation between this absorption and radiation dose has been shown to be linear. The infrared absorption of irradiated specimens and the mass-spectrographic examination of the gases evolved during irradiation are also discussed. (auth)

44237 (HW-SA-3055(Rev.)) IDENTIFICATION OF THE MOLTEN ZONE IN IRRADIATED UO_2. Glen R. Horn, James A. Christensen, and Linden A. Pember (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Nov. 11, 1963. Contract AT(45-1)-1350. 19p. (CONF-187-129)

From American Nuclear Society Meeting, New York, Nov. 1963.

The various thermal history interpretations of post-irradiation microstructures of ceramic fuel elements are discussed. Several experiments were performed on UO_2 pellets containing tungsten marker wires and randomly dispersed tungsten spheres. The results confirm the hypothesis that melting initially occurred to the outer edge of the porous zone within the columnar grains. Typical examples of the microstructure at the initial solid-liquid interface in irradiated UO_2 and UO_2-ThO_2 are given. (D.L.C.)

44238 (NARF-63-14T) EFFECTS OF NUCLEAR RADIATION ON POLY(N-VINYL CARBAZOLE). E. G. Fritz (General Dynamics/Fort Worth. Div. of General Dynamics Corp., Fort Worth, Tex.). Mar. 31, 1964. Contract AF33 (657)-7201. 28p. (MR-N-307; AD-603443)

The stress-strain behavior, Shore-D hardness, and O_2-sorption of poly(N-vinyl carbazole) were studied as a function of dose absorbed in the mixed radiation field of a nuclear reactor. The xamples were irradiated in air at room temperature to three different doses: 5.9×10^9, 1.1×10^{10}, and 6.4×10^{10} ergs/gm(C). Within this dose range, the elastic modulus increased slightly with dose but the general shape of the stress-strain curve was not changed by radiation. It could not be unequivocally established if ultimate tensile strength behavior was significantly affected by radiation. At a significance level of 0.01 the tensile strength appeared unaffected, while at a significance level of 0.025 the results of the analysis suggested an initial increase at 1.1×10^{10} ergs/gm(C) followed by a small decrease at the highest dose. No significant change in Shore-D hardness was observed. The postirradiation sorption of O_2 in irradiated PNVC increased with absorbed dose up to a saturation value. On the basis of oxygen sorption, the G(scission)-value was roughly estimated to be 0.128 scissions/100 ev. (auth)

44239 (RSIC-150(Vol.I)(App.A)) SPACE ENVIRONMENTAL EFFECTS ON MATERIALS AND COMPONENTS. VOLUME I. ELASTOMERIC AND PLASTIC MATERIALS. APPENDIX A. ELASTOMERS. (Army Missile Command, Redstone Arsenal, Ala.). Apr. 1, 1964. 118p. (AD-603365)

Tables and figures are presented on the effects of vacuum, high temperature, and radiation on various elastomers such as polyesters, neoprene, silicone rubber, and polysulfides. The properties studied include physical properties, weight loss, mechanical properties, and permeability. (D.L.C.)

44240 (AEC-tr-6475) THE EFFECT OF NEUTRON RADIATION ON INTERNAL FRICTION. S. T. Konobeevskii, N. F. Pravdyuk, Yu. I. Pokrovskii, and V. I. Vikhrov (Akademiya Nauk S.S.S.R. Ordena Lenina Institut Atomnoi Energii). Translation. 1962. 31p.

Results are reported of studies of the internal friction of Cu, Al, and Mg and the modulus of normal elasticity of Cu and Mo before and after irradiation. The effects of plastic deformation and fatigue on the internal friction were studied for Cu and Mg, respectively. (D.L.C.)

44241 (AI-Trans-58) STUDY OF IRRADIATION EFFECTS ON INDIUM ANTIMONIDE (thesis). Constantine-Demetre Georgopoulos (Grenoble, France. Universite). Translated by Anthony Cornell (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.), Sept. 1964. 88p.

After a consideration of the radiation effects on solids and semiconductors, an experimental study was conducted on the effects of neutrons and gamma rays on InSb and on the effects of annealing treatments. A model of the energy levels of the defects was developed which takes into account the annealing effects. It is pointed out that the graphic method of resolution of the neutrality equation allows an accurate analysis of the Fermi level changes during irradiation and annealing. (D.L.C.)

44242 (FTD-TT-64-506) CHANGES IN MECHANICAL PROPERTIES OF ORGANIC INSULATING MATERIAL DUE TO IONIZING RADIATION. Vladimir Adamec. Translated from Elektrotech. Obzor, 52: 406-11(1963). 16p.

Existing work on the radiation effects on organic electroinsulation materials are reviewed. An experimental study was conducted on the effects of reactor irradiation on several representatives of each of the classes plastics, vulcanizates, polyesters, pressed materials, layer materials, and paper and foil. The properties investigated were tensile strength, ductility, bending strength, hardness, and heat resistance. (D.L.C.)

44243 GAMMA-RAY ENHANCED DIFFUSION IN α-BRASS. R. E. Larsen and A. C. Damask (Brookhaven National Lab., Upton, N. Y. and Pitman-Dunn Research Inst., Philadelphia). Acta Met., 12: 1131-9(Oct. 1964). (BNL-7716)

Enhanced diffusion in α-brass was studied under gamma irradiation. The parameters varied were the flux, the temperature, and the dislocation content of the alloy. It was found that the diffusion enhancement is highly sensitive to the state of cold work of the material and that the enhanced diffusion coefficient can be reduced by a factor of five by a reduction in cross-sectional area of 0.5%. The flux dependence, although not precise, was concluded to be linear over the range of 1.7×10^5 to 4.7×10^6 R/hr. The temperature dependence is composed of a temperature dependent and a temperature independent part and it is shown that the data cannot be described by any of the three mechanisms of enhanced diffusion originally proposed by Dienes and Damask. A fourth mechanism is proposed in which a fraction of the vacancies anneal to dislocations and the remainder recombine with their own interstitials. It is shown that the data fit such a theory very well. On the basis of this model and the enhanced diffusion data of Arndt and Hines, which gave the migration energy of the vacancy as 0.8 ev, the migration energy of the interstitial is calculated to be 0.4 ev. The enhancement of diffusion by radiation permits the achievement of low temperature equilibrium states in alloys. The data obtained by this method show that the critical temperature for long-range order in 30% Zn α-

brass lies below 41°C, and kinetic evidence is presented that indicates that the critical temperature probably lies even below 0°C. (auth)

44244 FLUX DEPENDENCE OF NEUTRON-ENHANCED DIFFUSION IN α-BRASS. R. E. Larsen (Brookhaven National Lab., Upton, N. Y. and Pitman-Dunn Research Inst., Philadelphia), G. J. Dienes, and A. C. Damask. Acta Met., 12: 1141-6(Oct. 1964). (BNL-7715)

The flux dependence of neutron enhanced diffusion in α-brass was determined by exposing a series of samples to the leakage flux during two different Kiwi reactor test runs. The samples were placed at different distances from the reactor shell and were exposed, therefore, to different fluxes of the same energy distribution. The resistivity decrease arising from neutron enhanced short-range ordering was measured and compared with complete resistivity decay curves obtained in the Brookhaven reactor. The characteristic decay times obtained this way are inversely proportional to the diffusion coefficients. The results show that the radiation enhanced diffusion coefficient varies linearly with the neutron flux. This result, in combination with previous studies on the temperature dependence of enhanced diffusion, indicates strongly that the mechanism of defect annealing in α-brass during reactor irradiation is that of migration to and disappearance at fixed sinks. (auth)

44245 SYMPOSIUM ON THE CHEMICAL AND PHYSICAL EFFECTS OF HIGH-ENERGY RADIATION ON INORGANIC SUBSTANCES. Presented at the Sixty-sixth Annual Meeting, American Society for Testing and Materials, Atlantic City, N. J., June 25, 1963. ASTM Special Technical Publication No. 359. (American Society for Testing and Materials, Philadelphia). March 1964. 118p. $6.00.

Eight papers are included; separate abstracts were prepared for five. Three articles on use of color centers for detection and measurement of defects, low-energy radiation damage processes in a body-centered lattice, and effect of radiation on alkali halides were previously abstracted in NSA as: 17: 18853, 17: 20509, and 17: 34482. (P.C.H.)

For abstracts of individual papers see: 43459, 43603, 43604, 44246, and 44247.

44246 THERMAL DECOMPOSITION OF IRRADIATED NICKEL OXALATE. E. G. Prout and M. E. Brown (Rhodes Univ., Grahamstown, S. A.). Am. Soc. Testing Mater., Spec. Tech. Publ., 359(1963), 38-49(1964).

The thermal decomposition of dehydrated nickel oxalate was accelerated by preirradiation with γ rays (about 1.1 Mev). The acceleration was preceded by an initial deceleratory reaction that obeys the unimolecular decay law. The pressure of gas liberated in this reaction was proportional to the γ-ray dose. It is suggested that preirradiation produces nickel and an unstable intermediate that decomposes on heating. During the acceleratory and decay periods decomposition occurs by the Prout-Tompkins mechanism. (auth)

44247 X-RAY DIFFRACTION STUDIES OF SILVER PERMANGANATE. E. G. Prout and G. S. Woods (Rhodes Univ., Grahamstown, S. A.). Am. Soc. Testing Mater., Spec. Tech. Publ., 359(1963), 50-7(1964).

Laue, rotation, and Weissenberg photographs were taken of unirradiated and heavily irradiated (1.1 Mev γ rays) crystals of silver permanganate. Electron density profiles show that within experimental error, no displacement of silver or manganese atoms occurs during irradiation. It is suggested that ionization and bond rupture of the MnO_4-group takes place during irradiation. The Laue and rotation photographs taken at different stages of thermal decomposition support the mechanism previously advanced for the decompositions. (auth)

44248 SPACE RADIATION EFFECTS. Presented at the Sixty-sixth Annual Meeting, American Society for Testing and Materials, Atlantic City, N. J., June 26-27, 1963. ASTM Special Technical Publication No. 363. (American Society for Testing and Materials, Philadelphia). July 1964. 164p. $7.50.

Separate abstracts were prepared for four papers on the properties and simulation of space radiation and on space radiation effects on components and systems. The other nine papers were previously abstracted for NSA (17: 29480, 32692, 34523, 34524, 34525, 39991, and 18: 2383, 10262, 12758). (D.C.W.)

For abstracts of individual papers see: 43901, 44249, 44250, and 44482.

44249 SPACE RADIATION EFFECTS ON COMPONENTS AND SYSTEMS. P. H. Miller, Jr., and V. A. J. van Lint (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Am. Soc. Testing Mater., Spec. Tech. Publ., 363(1963), 67-75(1964).

The relation between radiation effects and the type of incident radiation is discussed on the basis of available theory. Radiation effects can be separated into three categories: displacement, transient, and chemical radiation effects. Within each category the primary radiation interactions can be utilized to determine the relative effectiveness of different incident radiations in producing the effect. Components and materials for use in space applications are discussed in order of their sensitivity to space radiation. The total environment must be simplified to develop radiation effects test programs. The use of theoretical information in establishing the validity of these simplifications is discussed. Finally, the relative merits of three classes of hardening methods (shielding, component and material substitution, and system design) are discussed. (auth)

44250 FORUM: NUCLEAR RADIATION EFFECTS ON MATERIALS FOR SPACE APPLICATION. Lowell K. Zoller (George C. Marshall Space Flight Center, Huntsville, Ala.). Am. Soc. Testing Mater., Spec. Tech. Publ., 363 (1963), 134-58(1964).

The effects of radiation, together with vibration, high and low temperatures, vacuum, and reactive chemicals on materials used in space vehicles are discussed. Multiple-environment testing is also considered, and some specific studies are summarized. (D.C.W.)

44251 THE BEHAVIOR OF IRRADIATED MICROSECTIONS. B. Weiss. Berg. Huettenmaenn. Monstah. Montan. Hochschule Leoben, 109: No. 3, 76-9(Mar. 1964). (In German)

A metallographic investigation of Ge, Cu, austenitic-martensitic steel, Al, and Al-Cu alloy surfaces was made by optical and electron microscopy. The effects of alpha irradiation on the surface structure of metals and alloys was investigated. (Rev. Metal Lit., 21: No. 9, Sept. 1964)

44252 INTERSTITIAL AND VACANCY LOOPS IN GRAPHITE IRRADIATED AT HIGH TEMPERATURES. P. A. Thrower (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Brit. J. Appl. Phys., 15: 1153-9 (Oct. 1964). (AERE-R-4612)

An electron microscope examination of neutron damage in graphite single crystals irradiated at 900 and 1200°C reveals two types of defect, which were identified by detailed studies of their diffraction contrast. Large inter-

stitial loops of radius about 350 Å are surrounded by small vacancy loops which appear to form in their stress fields. After annealing at 1820°C some of the interstitial loops have sheared to a configuration of lower stacking fault energy. This behavior is unexpected and casts doubt on previous identifications of defect loops in graphite. A possible mechanism for this phenomenon is discussed, and the A over A stacking fault energy is estimated to be about 70 erg cm^{-2}. (auth)

44253 EFFECT OF LOW COMPRESSIVE STRESSES ON RADIATION-INDUCED DIMENSIONAL CHANGES IN GRAPHITE. W. C. Morgan (General Electric Co., Richland, Wash.). Carbon, 1: 255-61(Apr. 1964). (HW-SA-2925)

When graphite is employed as a reactor moderator, the variations of temperature and neutron flux within the moderator bars cause internal stresses to be generated in the graphite. The effect of these stresses on the dimensional changes of the graphite are of immediate interest in the field of reactor design. Samples of five nuclear-grade graphites were irradiated under constant compressive stresses of 150 and 300 psi. Length changes of the stressed samples were compared with length changes of unstressed control samples, irradiated in the same assembly. Results obtained at 625°C and for exposures up to 6500 Mwd/At in a Hanford irradiation facility are presented. Additional data on one nuclear-grade graphite, irradiated under 100 psi constant tensile stress, are included. (auth)

44254 THE CATALYTIC OXIDATION OF IRRADIATED GRAPHITES. E. A. C. Follett (Univ. of Glasgow). Carbon, 1: 329-32(Apr. 1964).

The distribution of colloidal impurity and its influence on the air oxidation of irradiated and unirradiated synthetic graphites was studied by examination of thin flakes in the electron microscope. Colloidal particles of ferric hydroxide were found to be strongly adsorbed on to the edges and surfaces of the (0001) layer net planes of both irradiated and unirradiated specimens although a higher particle density was noted on irradiated material. No comparable adsorption was achieved with gold and silver colloids. On oxidation of unirradiated specimens, the colloidal particles of ferric hydroxide were observed to catalyze the oxidation at only the layer net edges of the component crystallites. In irradiated specimens, catalytic oxidation also occurred at reactive sites within the layer nets and resulted in the production of extensive deep pits, the pit density being governed by irradiation dose and temperature. The reactive sites were most probably vacancies introduced into the lattice by neutron irradiation. (auth)

44255 THE THRESHOLD CURVE FOR THE DISPLACEMENT OF ATOMS IN GRAPHITE: EXPERIMENTS ON THE RESISTIVITY CHANGES PRODUCED IN SINGLE CRYSTALS BY FAST ELECTRON IRRADIATION AT 15°K. M. W. Lucas and E. W. J. Mitchell (Thomson Physical Lab., Reading, Berks, Eng.). Carbon, 1: 345-52(Apr. 1964).

Natural single crystals of graphite were irradiated at 15°K with electrons in the energy range 0.3 to 2.0 Mev. Measurements were made of the change of resistivity with electron dose at all energies. The resistivity changes were found to vary linearly—with some scatter believed to be associated with temperature fluctuations—with electron dose at rates ranging from: $\Delta\rho/\rho_0\Delta D = 3.76\%$ per 10^{16} e^- cm^{-2} at 2.0 Mev, to $\Delta\rho/\rho_0\Delta D < 0.3\%$ per 10^{16} e^- cm^{-2} at 0.3 Mev. At 2.0 Mev the absolute resistivity change was 1.77×10^{-7} Ω cm per 10^{16} e^- cm^{-2}. The variation of these rates with electron energy was compared with calculations of the displacement of atoms, including for the higher electron energies a correction for the production of secondary displacements. A displacement energy of 60 ev gives agreement (± 10 ev) with the shape of the experimental curve. Using the value of 60 ev the cross section for producing displacements is 7.1 barns at 2.0 Mev. From this value it was calculated that at 2.0 Mev one incident electron per cm^2 produces 0.8 displaced atoms per cm^3 and consequently that the resistivity change is $2.53 \cdot 10^{-2}$ Ω cm per 1% defects. The resistivity change appears primarily to arise from changes in carrier scattering. The recovery of the resistivity was studied for annealing between 15 and 300°K. No change was observed between 15 and 80°K. Above 80°K the peak observed by others in polycrystalline graphite was found in the single crystal specimens. It is not possible yet to decide unequivocally about the nature of the process giving rise to the peak. The main reason for this is that one is not in a position to say that low energy defect movements have not allowed simple interplanar aggregates of interstitials to form even at 15°K. (auth)

44256 NEUTRON IRRADIATION AND SURFACE HOMOGENEITY OF GRAPHITIC MATERIALS. D. A. Cadenhead (State Univ. of New York, Buffalo). Carbon, 1: 429-33(July 1964).

The possibility of assessing by means of sorption techniques the surface damage due to neutron irradiation of graphitic materials was investigated. Samples of a graphitized carbon-black (S6-D3) were subjected to an integrated neutron flux of 2.6×10^{19} and 4.7×10^{20} n/cm^2 of both thermal and fast neutrons. In each case the form of the argon isotherms determined at 77°K indicated that the homogeneity of the surface remained essentially unchanged. For the more extensive irradiation a significant reduction in the surface area was observed. A sample of a non-graphitized carbon-black (S6) was also exposed to a thermal and fast-neutron flux of 5.0×10^{20} n/cm^2, but showed little or no tendency to form a more homogeneous surface. These observations may be explained by the ease of migration of displaced atoms to either previously vacated sites or the edges of crystallites. (auth)

44257 RADIATION-INDUCED CREEP IN GRAPHITE. A. J. Perks and J. H. W. Simmons (Atomic Energy Research Establishment, Harwell, Berks, Eng.). Carbon, 1: 441-9 (July 1964). (AERE-R-4372)

Experiments on radioinduced creep in graphite, carried out in the high-flux reactor PLUTO at Harwell, are described. Samples of graphite were loaded under tension at about 500 psi and their subsequent changes in length were compared with the changes in length of similar samples irradiated with no stress and those of samples held in the same stress and at the same temperature out of pile. The results clearly indicate the existence of a radioinduced creep strain. Experiments were also carried out on the effect of annealing both with and without stress on the lengths of samples that had received no previous treatment, and on samples that had been irradiated under stress. Alternative explanations of radiation creep are discussed. It is suggested that radiation creep plays a part in the dimensional changes of graphite irradiated without an external load. (auth)

44258 REACTIONS OF CARBON WITH CARBON DIOXIDE ACTIVATED BY LOW VOLTAGE ELECTRONS. K. T. Claxton and R. F. Strickland-Constable (Imperial Coll. of Science and Tech., London). Carbon, 1: 495-501 (July 1964).

An oxide coated emitter provides electrons that are accelerated in a field of 25v in a stream of CO_2 at a low pressure; a film of carbon deposited on metal foil is also present in the same vessel. The excited CO_2 reacts with the

unheated carbon; the rate of attack is independent of the sign of any electric potential applied to the carbon. The excited species are therefore uncharged and are probably O atoms, or an excited CO_2 molecule. In the presence of carbon the electron emission current remains substantially constant; but if the carbon is omitted from the reaction vessel the electron current falls rapidly. In the latter case the active species presumably attack the oxide-coated filament (at 900°C). In the former case they must react preferentially with the cold carbon. If static charges of either CO_2 or CO react with carbon in the presence of 25v electrons the final ratio of CO/CO_2 of 4 : 1 is the same in both cases. (auth)

44259 ELECTRON MICROSCOPE OBSERVATIONS OF IRRADIATED GRAPHITE SINGLE CRYSTALS. W. Bollmann and G. R. Hennig (Argonne National Lab., Ill.). Carbon, 1: 525-33(July 1964).

Graphite single crystals were studied by dark field transmission electron microscopy after irradiation with fast neutrons between 5.2×10^{17} and 1.5×10^{20} n/cm^2 at temperatures below 150°C. Subsequent annealing was investigated up to 2000°C. For comparison, specimens irradiated by electrons ^{12}C-ions, and fission fragments were studied. Contrast effects were calculated by means of the kinematical theory of electron diffraction. The distribution of vacancies was studied by a surface etch and surface decoration technique. All the observations are compatible with the assumption of the primary formation of independent interstitials and vacancies and subsequent clustering of only the interstitials. Only a small fraction of these clusters can be resolved by electron microscopy; these contain about 1 per cent of the originally displaced atoms. At a dose above 10^{20} n/cm^2 more complex phenomena were observed. (auth)

44260 MODIFICATION OF THE ELECTRICAL CONDUCTIVITY OF INSULATING LIQUIDS UNDER NUCLEAR IRRADIATION; APPLICATION TO THE DETECTION OF PARTICLES. D. Blanc, J. Mathieu, and P. Vermande (Centre de Physique Nucleaire, Faculte des Sciences, Toulouse). Dielectrics, 1: 215-20(Feb. 1964). (In French)

A review is given on the studies on the detection of radiation using ionization chambers filled with dielectric liquids. The conduction mechanism and some methods for the measurement of ionic mobilities are briefly discussed. The behavior of the liquids in very high electric fields is not considered. 55 references. (J.S.R.)

44261 BEHAVIOUR OF THERMOCOUPLES UNDER IRRADIATION. G. Bianchi and S. Moretti (CNEN, Rome). Energia Nucl. (Milan), 11: 426-31(Aug. 1964).

The results of a thermocouple irradiation test experiment performed at Ispra from November 25, 1961 up to July 15, 1962 are given and discussed. Conceptual limitations on the experiment together with considerations on inhomogeneous thermocouple characteristics are also reported. As a conclusion of the work, suggestions for further experiments are given. (auth)

44262 RADIATION EFFECTS ON MECHANICAL PROPERTIES OF ZINC MONOCRYSTALS IN THE PRESENCE OF SURFACE ACTIVE METALLIC MELTS. O. A. Troitskii and I. G. Berezina (Inst. of Physical Chemistry, Academy of Sciences, USSR). Fiz. Metal. i Metalloved., 18: 125-31(July 1964). (In Russian)

Proton irradiation produced an anisotropic effect in the deformation of zinc monocrystals. The anisotropic effect eased crystal slippage along the joints of planes {0001} parallel to the radiation beam. Continuous proton and neutron irradiation of zinc monocrystals coated with thin layers of mercury produced a sharp drop in yield strength. (tr-auth)

44263 DETERMINING THE RATE OF INJECTING A CENTERS IN IRRADIATED SINGLE CRYSTALS OF SILICON THROUGH THE 9 MICRON ABSORPTION BAND. E. N. Lotkova. Fiz. Tverd. Tela, 6: 1559-60(1964).

Absorption was investigated in samples cut from one single crystal of silicon and irradiated with different doses of fast neutrons: $3 \cdot 10^{17}$, $6 \cdot 10^{17}$, $9 \cdot 10^{17}$, and $5 \cdot 10^{18}$ $n_0$cm^2. It was found that, along with the 9-μ band, a 9.6-μ band was also observed in weakly irradiated samples. This band was ascribed to vibration of the Si–O bond in SiO_4 groups, which are present in high concentration in heat-treated silicon. With increased dosage of radiation, the 9.6-μ band began to disappear, but the intensity of the 9-μ band did not change until the 9.6-μ band disappeared; then it began to diminish. This may mean that the Si–O bond in the compounds is weaker, that is easily broken, and that atoms of oxygen from the compounds are important participants in the formation of A centers. Only when all the oxygen from these compounds is utilized do interstitial oxygen atoms participate in the formation of A centers, and the corresponding absorption at 9-μ begins to decrease because of the oxygen atoms going into the formation of the A centers. (OTS)

44264 ON THE ABSORPTION BANDS IN THE NEAR INFRARED REGION OF IRRADIATED SILICON SINGLE CRYSTALS. E. N. Lotkova. Fiz. Tverd. Tela, 6: 1905-7 (1964).

An experimental investigation was made on the 1.8-μ band in the absorption spectrum of Si single crystals irradiated with fast neutrons and electrons. Within the range of irradiation doses of 10^{17}–10^{18} neutrons/cm^2, absorption intensity increased linearly with the increase of the dose. A decrease in temperature resulted in a shift of the maximum; e.g., at 77°K it is located at 1.7 μ. Further temperature decrease to 14°K did not bring about further shifts. The shape of the observed band showed a close similarity to Gaussian distribution. For the spectra of both n-type and p-type specimens, the width at half-power points of the band was 0.10 ± 0.01 ev at 77°K and 0.16 ± 0.01 ev at 300°K. Following irradiation by an electron flow of 10^{18} electrons/cm^2 with an energy of 1.2 Mev, the absorption intensity of the 1.8- and 3.5-μ bands proved to be almost identical to that resulting from irradiation with a similar neutron flow. Following irradiation with neutrons of high-resistance n- and p-type Si single crystals, a new absorption band of 1.23 μ ($h\nu$ = 1.02 ev) was detected. (OTS)

44265 STUDY OF RADIOLOGICALLY INDUCED CONDUCTIVITY IN HIGH-PRESSURE POLYETHYLENE. E. Fallah. Ind. Plastiques Mod. (Paris), 15: 37-44(Nov. 1963).

The temporary effects of x rays on the electrical properties of high-pressure polyethylene were studied. A detailed description of the test conditions is given; characteristics of the polyethylene, preparation of the samples, circuitry of the measuring device, and irradiating conditions of the samples by the reactor Triton and a cobalt source. (auth)

44266 THE EFFECT OF OXIDATION ON THE REACTIVITY OF NUCLEAR GRAPHITE TOWARDS AIR. A. R. Blake (Central Electricity Generating Board, Berkeley, Gloucestershire, Eng.). J. Appl. Chem. (London), 14: 382-8(Sept. 1964).

The changes in the reactivity of nuclear graphite toward air following thermal and radiolytic oxidation were examined. The increase in reactivity on thermal oxidation is independent of the initial reactivity, and results are reported from which predictions of the reactivity of oxidized

graphite can be made. The rate of reactivity rise with radiolytic burn-off is greater than for thermal burn-off, but the limiting reactivity at high burn-off is similar. The difference in the oxidation rates of the various specimens examined is apparently associated with the properties of the initially accessible surface and not with a bulk condition. (auth)

44267 GRAPHITE WIGNER ENERGY RELEASE. M. C. Wittels. Nucl. Safety, 5: 336-8(1964).

Recent results from investigations of Wigner energy release from graphite are examined. Discussions are included on cryogenic studies of irradiated graphite, isothermal measurements of energy release, monitoring instruments, and graphite-reactor annealing. (J.R.D.)

44268 INTEGRITY OF CERAMIC REACTOR FUELS. Sigfred Peterson. Nucl. Safety, 5: 338-42(1964).

A review of the properties of ceramic fuels is presented. Emphasis is placed on UO_2, and comments concerning other fuels such as UN, plutonia-base, zirconia–urania, beryllia-base, carbide, and graphite-base are included. (J.R.D.)

44269 FISSION-PRODUCT RELEASE FROM UO_2. R. M. Carroll. Nucl. Safety, 5: 356-60(1964).

Discussions and data are summarized that confirm the incorrectness of assumptions used in current models of fission product diffusion in UO_2. It is concluded that a simple diffusion model cannot be used. Factors such as UO_2 lattice defects and fission rates must be considered along with the amount of burnup that has occurred. (J.R.D.)

44270 ALPHA-IRRADIATION-INDUCED REMOVAL OF STACKING-FAULT TETRAHEDRA IN QUENCHED GOLD. R. M. J. Cotterill and M. W. Jones (Cambridge Univ., Eng.). Phil. Mag. (8), 10: 535-49(Sept. 1964).

Specimens of quenched gold, 1000 Å thick and containing a high concentration of stacking-fault tetrahedra, were examined in the electron microscope before and after irradiation with alpha particles. Irradiation caused the tetrahedra to disappear. It also produced small regions of damage, which are characteristic of irradiation experiments. The results were consistent with a model in which the tetrahedron gradually accretes interstitials until it has collected a certain number, $n_{CRIT.}$, of them. It then breaks up rapidly. The value of $n_{CRIT.}$ is of the order of 300. The interstitial accretion may be a result of momentum defocusing at the stacking-fault faces of the tetrahedron. The small regions of damage were believed to be clusters of approximately 500 vacancies. There were indications that they are found at displacement spikes. (auth)

44271 THE ABNORMAL VOLATILITY OF α-IRRADIATED MATERIALS. N. Riehl and R. Sizmann (Technische Hochschule, Munich). Radiochim. Acta, 3: 44-7(Oct. 1964). (In German)

It is shown that recoil atoms have a strong sputtering effect on solids. The abnormally high volatility of alpha emitters is attributed to this phenomenon. Studying the temperature dependence of the volatility of a ^{210}Po sample it was possible to separate the common evaporation (dominant at high temperatures) from the sputtering effect. (auth)

44272 POTENTIAL DISTRIBUTION ON A DIELECTRIC TARGET SURFACE IRRADIATED BY ELECTRON BEAM. V. L. Gerus. Radiotekhn. i Elektron., 9: 1420-32 (Aug. 1964). (In Russian)

Dynamic variations in the equilibrium potential distribution on a dielectric surface under a scanning beam were investigated. It is shown that with increased beam current the potential distribution changes the target potential from a given value below the so called equilibrium potential to an equal value above the equilibrium potential, producing the characteristic effect of static beam irradiation. (tr-auth)

44273 EFFECTS OF NUCLEAR RADIATION ON MATERIAL SURFACES. Rudolf Neider (Bundesanstalt fur Materialprufung, Berlin). Umschau Wiss. Tech., 64: 530-3(Sept. 1, 1964). (In German)

A brief review is given of the results obtained in studies of surface effects induced by nuclear radiation. The modification of the surface structure, changes in the oxidation and reduction processes, alteration in corrosion phenomena, and changes in plastic surfaces are the topics discussed. (J.S.R.)

44274 SPACE RADIATIONS AND THEIR EFFECTS. R. S. Barnes. p.205-14 of "Materials in Space Technology." London, Iliffe Books Ltd., 1963.

The interaction of radiation with matter in space is discussed on the basis of electron interaction and atomic displacements. Results of the introduction of impurities in materials by irradiation are described. The energy of radiations in space was found to be such that it is likely to prevent any radiation-sensitive material being used for a space-vehicle shell. However, it was concluded that metals are not likely to be affected. Surface effects, such as erosion by collision with gas atoms, formation of interstitial atoms, and sputtering, are described. Micrometeorite effects on the surface of the vehicle are also considered. (M.C.G.)

44275 HIGH-ENERGY RADIATION EFFECTS ON MATERIALS. A. Charlesby and D. K. Thomas. p.215-45 of "Materials in Space Technology." London, Iliffe Books Ltd., 1963.

The general character of the interaction of radiation with matter is surveyed, including the penetration of materials by radiation and the specific form this takes in metallic, covalent, and molecular structures. Topics covered include: ionization by protons, electrons, and bremsstrahlung; nuclear displacement; influence of structure on radiation damage, for metallic structure, covalent lattices, transistors, solar cells, and molecular structures; properties of galactic cosmic radiation, solar protons, and geomagnetically trapped radiation; radiation damage in space; and radiation lifetime of materials in space. (M.C.G.)

44276 CALCULATIONS OF CURRENT PULSES AND INTENSITY PRODUCED BY IONIZING PARTICLES PENETRATING THROUGH SEMICONDUCTOR SURFACE. V. M. Lenchenko and I. Iminov. p.49-58 of "Radiatsionnye Effekty v Kondensirovannykh Sredakh." Tashkent, Publishing House of the Sciences, 1964. (In Russian)

The current and voltage pulses were calculated for germanium and silicon surface-barrier counters, which are used in the measurement of charged particles. It was assumed that at $t = 0$ the ionized region in the counter has the form of a cylinder of length χ_0 and radius ρ_0 with the excess carriers homogeneously distributed within this cylinder. Also the lifetimes of electrons and holes within the cylinder and outside it did not vary because of the small concentration of non-equilibrium current carriers. It was assumed that a heavy charged particle such as an α particle strikes the silicon counter, and interacts to form electrons and holes. Expressions were obtained for the total pulse current I created by the α particle, and also for the pulse voltage V. The values of I and V were independent of the cylinder radius ρ_0 because of the assumption that the

lifetime and recombination rate are not dependent on the density of electrons and holes. The current and voltage pulses were plotted as a function of time. The fronts for the drop in current and the rise in voltage were 10^{-7} sec with the pulse current asymptotically tending to zero. The maximum pulse voltage was found to be V_{max} = 1.67 Mev for a concrete case. (TTT)

44277 THE ENERGY DEPENDENCE OF ELECTRON DAMAGE IN SILICON. R. G. Downing, J. R. Carter, and J. M. Denney (TRW Space Technology Labs., Redondo Beach, Calif.). 32p. (CONF-657-3)

From 4th Annual Photovoltaic Specialists Conference, Cleveland, June 1964.

Experiments on Si were made to obtain statistically significant and accurate data on the energy dependence of electron radiation damage, to determine the effect of resistivity on the damage rate and energy dependence, and to obtain added specimens and information for further analysis of the energy levels and defect mechanisms responsible for electron radiation damage in Si. The first two objectives were accomplished resulting in an accurate energy dependence function over the practical range of interest from 0.4 to 40.0 Mev. Estimation of solar cell radiation damage and subsequent power supply degradation in space for n on p cells of any resistivity can be performed with the results of these experiments to an accuracy better than the knowledge of the radiation environment in space. The data obtained on the energy levels responsible for the observed degradation of minority carrier lifetime do not yet form a consistent picture. (P.C.H.)

44278 RADIATION EFFECTS ON POLYCRYSTALLINE SOLAR CELLS. E. L. Ralph and P. Berman (Heliotek, Sylmar, Calif.). 16p. (CONF-673-1)

From 18th Annual Power Sources Conference, Fort Monmouth, N. J., May 1964.

Polycrystalline 10 ohm cm N^+/P silicon solar cells were experimentally irradiated and analyzed and currents of 57 mA initially and 48 mA after 10^{16} e/cm were obtained, showing reasonable agreement to theory. The low minority carrier lifetime polycrystalline cells were superior based on percentage power drop. On an absolute basis, however, the cells do not equal the performance of the single crystalline cells until 1 Mev electron fluxes of 10^{14} to 10^{15} e/cm^2 are attained. The results showed that the polycrystalline cells exhibit equivalent or higher absolute power output at fluxes higher than 10^{14} e/cm^2 indicating that the cells may have a smaller damage constant, K. It is noted that a relative comparison of cell performance after nuclear irradiation, using the I/I_0 ratio or P/P_0 ratio, can give a distorted picture of the actual results since it tells nothing about the actual power outputs at a particular flux level. (P.C.H.)

METEOROLOGY

Refer also to abstracts 43752 and 44644.

44279 (AWRE-O-59/64) THERMAL MECHANISMS AT HIGH ALTITUDE. R. J. Wilson (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Aug. 1964. 13p.

A summary of the thermal mechanisms involved in the development of a nuclear explosion at altitudes greater than 25 km is given. The form of the pulse of thermal radiation at the ground is shown to change gradually from the double peaked form observed for low air bursts to a faster, monotonically decreasing pulse for altitudes of detonation above 80 km. Some numerical estimates of the relative energy radiated by the different mechanisms are given and some of the uncertainties associated with such calculations indicated. It is pointed out, however, that the lack of data on the response of targets to thermal pulses of this general nature represents a more serious limitation than uncertainties of prediction in assessing the thermal hazard from a high-altitude nuclear explosion. (auth)

44280 (LA-DC-6106) SOURCE MEASUREMENT: DETERMINING THE RELEASE FROM A POINT SOURCE BY REMOTELY LOCATED SAMPLERS. Richard W. Henderson and Jesse W. T. Meadows (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 9p.

The effluent from some chemical and nuclear processes may be offensive or constitute a health hazard. Proper control requires a knowledge of the source characteristics. Often, measurement of the source cannot be accomplished by a direct technique. By employing a distant, circular sampling array, Sutton's equation can be modified for the calculation of the release from any such inaccessible point source. (auth)

44281 (VUF-1008) WEATHER AND SURFACE RADIATION PREDICTION. [Final Report]. A. N. Hull, R. W. Titus, and H. F. Mueller (Weather Bureau, Las Vegas, Nev.). June 1964. Project SHOAL. 44p.

The Weather and Surface Radiation Prediction Unit commenced preliminary weather observations at the SHOAL Site in August 1962. Sufficient data were collected to ensure statistical significance. Commencing on D-30, a complete weather analysis and forecasting unit was in operation at the SHOAL Site. The weather facilities, observation schedules, detailed pre-shot weather and radiation forecasts, and their verification are discussed. (auth)

44282 ATMOSPHERIC DIFFUSION EXPERIMENTS AND PREDICTION MODELS. James J. Fuquay and Charles L. Simpson. Nucl. Safety, 5: 403-7(1964).

A review is presented of information and data concerning environmental contamination resulting from continuous near-ground releases. Data from major U. S. diffusion studies are discussed and experimental data are compared with prediction model data. (J.R.D.)

44283 MEASUREMENT OF THE INTENSITY OF IONIZATION NEAR THE GROUND. APPLICATION TO THE STUDY OF RADIOACTIVE CONTAMINATION OF THE ATMOSPHERE. J. Bricard (Institut D'Optique, Paris), A. Doury, and P. Grevet. 8p. (CONF-337-30). (In French)

From International Conference on Radioactive Pollution of Gaseous Media, Saclay, France, Nov. 1963.

The apparatus used is a cylindrical chamber of 34 liters of useful volume. In order that the walls offer only a small uptake surface to external radiation, and that they not be poisoned by air turbulence, the cellophane envelope of the chamber is fixed on a metallic grid and the external electrode is constituted by a second coaxial grid of the same nature. The distance between the two grids is greater than the range of α particles. The chamber is filled with the air that is to be studied, and therefore both the ionization intensity owing to β and γ rays coming from external sources and the intensity corresponding to the α particles from aerosols and radon introduced in the chamber are measured. The total ionization intensity measured with this device in the absence of external perturbations is 12 ion pairs per cm^3 per second. Half of this has an α origin and the rest is attributable to external β and γ rays. (tr-auth)

PHYSICS

General

Refer also to abstracts 43151 and 43454.

44284 (AD-603951) MHD CHARACTERISTICS AND SHOCK WAVES. Research Report No. 185. A. R. Kantrowitz and H. E. Petschek (Avco Corp. Avco-Everett Research Lab., Everett, Mass). July 1964. Contract AF49(638)-659. 71p.

A review of the theory of MHD characteristics and shock waves is presented. Primary emphasis is placed on a physical discussion of the three characteristic modes and the jump conditions for the two types of shock waves that can exist. Brief discussions of shock structure, applications of the theory, and the range of applicability of the continuum equations are also given. The report was prepared as a chapter in a book on plasma physics to be edited by Wulf B. Kunkel. (auth)

44285 (AFCRL-63-898) SHOCK RELATIONS IN A DENSE HIGH-TEMPERATURE GAS. Scientific Report No. 2. Ik-Ju Kang and Jack S. Goldstein (Brandeis Univ., Waltham, Mass.). Mar. 21, 1963. Contract AF19(604)-7283. 20p.

Shock relations are established for the dense high temperature gas, ($\rho \sim 10^9$ gr/cc, $T \sim 10^{9}$°K), introducing relativistic concepts. It is assumed that the self-consistent static electric field does not play a significant role in the shock relations. From these relations, the heating effect due to the passage of the shock waves through a degenerate gas is deduced explicitly, indicating large heating effects. The results may be of significance in understanding the supernova phenomenon. (auth)

44286 (BNL-8408) MÖSSBAUER STUDIES OF A DILUTE Fe IN Pd ALLOY IN EXTERNAL MAGNETIC FIELDS. Romeo Segnan, Paul P. Craig, and Robert C. Perisho (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT(30-2)-Gen-16. 12p. (CONF-651-6)

From 9th International Conference on Low Temperature Physics, Columbus, Ohio, Aug.-Sept. 1964.

A study was made of the hyperfine magnetic fields at ^{57}Fe nuclei in $Fe_{2.65}Pd_{97.35}$ both above and below the Curie temperature θ and in externally applied magnetic fields. The results indicate that the relation $H_i/H_{sat} = M/M_{sat}$ is not obeyed. The zero external field results can be described by a Brillouin function model with $J = 1$, while in external magnetic fields, $J = 1$ gives a reasonable fit at low temperatures and $J = {}^{13}/_{2}$ at high temperatures. (D.L.C.)

44287 (LA-DC-5724) ELECTRON WAVE FUNCTIONS IN LIQUIDS. David Liberman (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 20p.

It is shown that the wave function of an electron in a liquid may be obtained without resort to perturbation theory by consideration of the scattering from a single ion in the liquid. Two approximations are involved. One is a slightly different form of the usual adiabatic approximation, the other an approximation for the three-particle distribution function of the liquid in terms of the two-particle distribution function. Numerical calculations were not made, but should be somewhat easier than for solids because of the isotropy of liquids. (auth)

44288 (NP-14347) NORMAL IONIZING SHOCK WAVES. Report No. 12. R. Taussig (Columbia Univ., New York. School of Engineering and Applied Science). July 1964. Contract AF49(638)-1254. 56p.

Solutions to the steady-state jump equations are obtained for a normal ionizing shock wave propagating into a non-conducting, quiescent gas in an electromagnetic field. Comparison of these solutions to pure MHD shocks and ordinary gas shocks indicates that ionizing shocks are hybrids having some properties common to both MHD and gas shocks. In addition, some completely novel effects are produced by the upstream electromagnetic field. For instance, the shock velocities are bounded for a given upstream electric field strength, for electric fields larger than a critical value, E^*, no steady compressive shocks exist, and for non-zero electric fields "switch-on" behavior is extended to slow shocks. A modified Rankine-Hugoniot function is derived and used to select physically reasonable shock solutions. Solutions analogous in some respects to detonation-deflagration waves were found, and the Chapman-Jouguet condition is applied to them. The complete boundary value problem is solved numerically in the context of an electromagnetic annular shock tube. Solution of the boundary value problem places the analytic results in the framework of experimentally observable phenomena and emphasizes the differences between ionizing shocks and MHD or gas shocks. (auth)

44289 (ORNL-3670(p.31-5)) SPECTROSCOPY OF IONIC MEDIA. G. P. Smith (Oak Ridge National Lab., Tenn.).

Computer calculations were made on the electronic states of some molecular and crystal systems, utilizing a previously developed general-purpose one-center expansion code. Problems investigated in this manner include the electronic states of the H_2^+ molecule, the potential energy surface of the H_3 system, the ground state of the carbon atom, the ground state of the CH_3^- molecule, and the electronic states of the F-center defect in alkali halide crystals. The F-center study included effects of lattice distortions and electronic structure on neighboring ions. Calculations are being made on the helium atom to test the utility of expansion forms having angular (rather than radial) interelectronic coordinates and many exponential parameters. A study of the construction of sets of orthogonal orbitals led to a technique of orthogonalization in such a way as to produce a wave function of minimum energy. The possible use of this technique to find natural-orbital expansions is being examined. A nonstandard least-squares method derived from numerical variational techniques has been applied in the interpretation of ligand-field spectra. The optical spectra of $NiCl_4^{2-}$, $NiBr_4^{2-}$, and NiI_4^{2-} in various liquid media were measured from 4000 cm^{-1} in the near infrared to about 40,000 cm^{-1} in the ultraviolet. These results give the most clear-cut evidence to date for geometrically regular complex ions in molten salts, and they were used to test theories of electronic spectra of transition-metal complexes. Of particular current interest are the ultraviolet spectra that provide information on the electron orbitals that are strongly associated with the halide ions. The optical spectra of solutions of $CuCl_2$ in molten chloride salts with large cations indicated the presence of tetrahedral or mildly distorted tetrahedral $CuCl_4^{2-}$ complexes. Although such entities are well known in crystals,

previous attempts to find them in liquid media had been unsuccessful. (auth)

44290 (ORNL-3670(p.54-5)) THEORY OF ELECTRONIC STATES IN SOLIDS. J. S. Faulkner (Oak Ridge National Lab., Tenn.).

The nature of the electronic states of liquid metals and random alloys is being studied by considering soluble one-dimensional models, developing and evaluating techniques for making reliable three-dimensional calculations for such systems, and investigating the application of existing theories to experimental work. (auth)

44291 (ORNL-P-400) A CORRELATION OF THE MÖSSBAUER ISOMER SHIFT AND THE RESIDUAL ELECTRICAL RESISTIVITY FOR ^{197}Au ALLOYS. Louis D. Roberts, Richard L. Becker, F. E. Obenshain (Oak Ridge National Lab., Tenn.), and J. O. Thomson (Tennessee. Univ., Knoxville). [1964]. Contract W-7405-eng-26. 19p. (CONF-651-9)

From 9th International Conference on Low Temperature Physics, Columbus, Ohio, Aug.-Sept. 1964.

Measurements of the isomer shift v_I of the resonance gamma ray energy and of the residual electrical resistivity $\Delta R/c$ are reported for ^{197}Au alloyed in Cu, Ag, Pd, Pt, and Ni. A correlation between v_I and $\Delta R/c$ is made using an impurity potential. Information is obtained on the impurity potential and the s-band filling, and the results indicate that in Au alloys or compounds where $v_I = 0$, the electron charge density near the Au nucleus is greater than that in pure gold. (D.L.C.)

44292 (ORNL-P-428) HYPERFINE STRUCTURE COUPLING IN FERRIC AMMONIUM SULFATE AS A FUNCTION OF MAGNETIC FIELD AND TEMPERATURE. F. E. Obenshain, L. D. Roberts, C. F. Coleman, F. W. Forester (Oak Ridge National Lab., Tenn.), and J. O. Thomson (Tennessee. Univ., Knoxville). [Aug. 31, 1964]. Contract W-7405-eng-26. 10p. (CONF-651-8)

From the 9th International Conference on Low Temperature Physics, Columbus, Ohio, Aug.-Sept. 1964.

The concept of an effective magnetic field in Mössbauer studies of hyperfine structure coupling in magnetic materials is discussed. Measurements on ^{57}Fe source and $FeNH_4(SO_4)_2 \cdot 12H_2O$ absorber were made at low temperatures with the absorber in a magnetic field of 24 kOe. The hyperfine structure spectra show that the effective field model does not give an adequate description of the behavior of ferric ammonium alum. (D.L.C.)

44293 (AERE-Trans-1010) MODEL CALCULATIONS OF X-RAY BRAGG REFLECTIONS FROM DISLOCATIONS. K. Drittler. Translated by Kathlyn Fforde (U.K.A.E.A. Atomic Energy Research Establishment, Harwell, Berks, Eng.), from Phys. Status Solidi, 4: No. 1, 71-88(1964). 27p.

Using Wilson's result, a Fourier series is obtained as an approximate expression describing the intensity distribution of x-ray interference reflections (Bragg-reflections, Debye-Scherrer-lines). The Fourier coefficients are calculated for some simple models of the crystalline environment of dislocations. It is shown, for example, that parallel screw dislocations in a crystal region are approximatively equivalent to a multiple dislocation with a Burgers vector equal to the sum of the Burgers vectors of the single dislocations. Mean values over the positions of the dislocations are claculated. The data in the literature are analyzed by a new method and compared with these calculations. Good agreement is obtained which leads to dislocation densities of the right order of magnitude. (auth)

44294 NOTE ON THE PERIODIC CLASSIFICATION OF THE ELEMENTS. G. E. Villar. Anales Real Soc. Espan. Fis. Quim. (Madrid), Ser. B, 60: 103-6(Feb.-Mar. 1964). (In Spanish)

A modification is proposed to the graphical periodic classification of elements, to make it evident that rare earth elements (lanthanide and actinide elements) are not d-transition elements but f-transition elements, and that their electronic configurations obey the following laws: $4f^n6s^2$ (n = 1 to 14) for the lanthanides, and $5f^n7s^2$ (n = 1 to 14) for the actinides. (auth)

44295 DOUBLE RESONANCE IN DIFFERENT DIRECTING FIELDS. M. You Hing Tchao (Faculte des Sciences, Paris). Ann. Phys. (Paris) (13), 9: 179-210 (Mar.-Apr. 1964). (In French)

After a brief review of simple magnetic resonance, the basic theory of double resonance is presented. The apparatus and the experimental techniques used in the study of simple magnetic resonance in different guide fields are described. The apparatus and experimental techniques used in the study of double resonance in different guide fields are discussed. (J.S.R.)

44296 APPROXIMATION METHODS FOR CALCULATION OF CLASSICAL ELASTIC SCATTERING OF TWO PARTICLES. Ditmar Heinrich (Zentralinstitut fur Kernphysik, Rossendorf, Ger.). Ann. Physik (7), 13: 284-93 (1964). (In German)

The integral occurring in the calculation of the scattering angle can be solved analytically only for a few potentials. Approximation methods and their limits of validity, which collectively make possible the analytical calculation of the scattering angle for almost all values of the collision parameters and energy, were indicated. The developments for large and small collision parameters include the minimum distance of the collision partners. Only the first approximation is suitable for large collision parameters in order to maintain, through an interpolation formula, the scattering angle for any collision parameter. At very sharp potentials, the development by powers of potentials becomes more suitable. In the first approximation the scattering between hard spheres is used. In the second approximation the scattering angle for all potentials was equal, which agreed in the minimum distance in size and sharpness. (tr-auth)

44297 ON LINEAR AND NON-LINEAR HYDROMAGNETIC FLUID MOTION GENERATED BY OSCILLATING SOLID BOUNDARIES. PART II. A. Kildal (Univ. of Bergen). Arbok Univ. i Bergen, Mat.-Nat. Ser., No. 8, 28p. (1964).

The time independent secondary motion generated by a plate, vibrating in a viscous and electric conducting fluid, is studied. General, formal expressions for the second order velocity and for the magnetic field are derived. It is also demonstrated that on letting $B_0 \to 0$ or $\sigma \to 0$ in the expressions for the velocity, the hydrodynamic results are obtained. Further some other limiting cases are treated. It is found that a weak magnetic field does not modify the first order hydrodynamic motion essentially. The same can be said about the second order motion in the region close to the plate. Sufficiently far from the plate, however, even a weak magnetic field modifies the secondary motion strongly. As a general feature it is found that in weak field cases the fluid forms two circulations. When the magnetic field is strong, the flow pattern is essentially deformed over the whole region occupied by the fluid. Instead of two circulations, only one is found. Results in conformity with the exact calculations were extracted from dimensional considerations. Numerical results are presented together with some comments on these results. (auth)

44298 CONTROL OF ATOMIC ENERGY IN FRANCE. Julien Vergne (Commissariat a l'Energie Atomique, Paris). Bull. Inform. Sci. Tech. (Paris), No. 83: 3-80(May 1964). (In French)

The judicial texts relative to the control of atomic energy in France are collated. The laws governing raw materials, nuclear installations, protection, security, civil responsibility, nuclear insurance, industrial operations, and foreign commerce are reported. The effect of the Euratom treaty on the judicial problems is considered. (J.S.R.)

44299 A DEMONSTRATION OF ALFVÉN WAVES. PART I. GENERATION OF STANDING WAVES. Antony Jameson ([Cambridge Univ., Eng.)]. J. Fluid Mech., 19: 513-27(Aug. 1964).

The equations for Alfvén waves are examined, and conditions necessary for the occurrence of resonance are determined. An experiment using liquid sodium inside a torus is described. Waves were generated by means of alternating current supplied to a coil around the torus. A strong resonance was observed at the fundamental frequency, and a weak resonance at three times this frequency. At the fundamental resonance the alternating magnetic field attained magnitudes more than 9 times the magnitude of the field that would have been generated in free space by the exciting current. The results were in agreement with prediction. (auth)

44300 INSTABILITY OF A VISCOUS FLUID OF VARIABLE DENSITY IN A MAGNETIC FIELD. N. T. Dunwoody (Queen's Univ., Belfast). J. Fluid Mech., 20: 103-13 (Sept. 1964).

The instability to small two-dimensional disturbances of an electrically conducting fluid of variable density is investigated. The viscous fluid is bounded between two vertical parallel planes, normal to which a magnetic field of constant intensity is applied. Significant parameters upon which the behavior of the Rayleigh number at neutral stability depends are the Hartmann number $\underline{M}$ and the wave-number, which is associated with a periodic disturbance with periodicity in the unbounded horizontal direction. The solution may be sought by considering basic disturbances, which are either symmetric or antisymmetric about the median plane parallel to the boundary planes. It is found that for a given magnetic field strength the critical Rayleigh number governing stability is associated with an antisymmetric disturbance of zero wave-number. The least stable symmetric disturbance, which arises when the wave-number is zero, is less easily excited. This trend is seen again in the purely hydrodynamic case ($M = 0$) where, corresponding to a finite wave-number value, the more unstable mode at neutral stability is found to be an antisymmetric one. The most unstable situation occurs when both the Hartmann number and the wave number are zero. In this case the minimum critical Rayleigh number is zero, and is associated with a symmetric disturbance. (auth)

44301 MAGNETIC CONFIGURATION OF A CYLINDER WITH INFINITE CONDUCTIVITY. Graziella Bardotti (EURATOM-CNEN, Rome), Bruno Bertotti, and Laura Gianolio. J. Math. Phys. (N. Y.), 5: 1387-90(Oct. 1964).

The magnetic configuration of a cylinder with infinite conductivity is calculated numerically for different values of the height 2h. The calculation indicates that the current density j(z) diverges at the edges as $I(h)/(h^2 - z^2)^{1/4}$ and permits the evaluation of the function I(h). The regular part of j(z) seems to be approximated by an elliptical profile. The case of a cut cylinder is also discussed. (auth)

44302 APPLICATION OF OPERATIONAL METHODS TO THE ANALYSIS OF THE MOTION OF RIGID BODIES. Saul Silven (Lockheed Missiles and Space Co., Sunnyvale, Calif.). J. Math. Phys. (N. Y.), 5: 1424-6(Oct. 1964).

Various types of gyroscopic precessional motion are discussed by the application of operational methods to the vector Euler equation describing the motion of a rigid body about a fixed point. Free precession and forced precessions due to external torques both fixed in the body and fixed in space are considered. (auth)

44303 IMPACT APPROXIMATION FOR LINE SHAPE IN THE MICROWAVE REGION. A. Di Giacomo (Scuola Normale Superiore, Pisa, Italy; Università, Pisa, Italy; and Istituto Nazionale di Fisica Nucleare, Pisa, Italy). Nuovo Cimento (10), 34: 473-91(Oct. 16, 1964).

A quantum-mechanical impact approximation theory is developed for the shape of spectral lines in the microwave region, in the limiting case of high temperatures and low pressures. Effects of the internal structure of the molecules and of their identity are taken into account. Possible correlations in successive collisions are discussed. (auth)

44304 SMALL AMPLITUDE HYDROMAGNETIC WAVES IN COMPRESSIBLE MEDIUM WITH HALL CURRENT. C. Uberoi and C. Devanathan (Indian Inst. of Science, Bangalore). Proc. Indian Acad. Sci., Sect. A, 60: 42-50(July 1964).

The propagation of small-amplitude hydromagnetic waves in a fully ionized, high-temperature, compressible gas is studied. At any angle between propagation vector and magnetic field (with the exception of the degenerate case of 90°), there exist three elliptically polarized waves, the first carrying principally the magnetic energy, the second (which is a modified sound wave) carrying the thermal energy, and the third being propagated only if the frequency of the wave is below a critical frequency depending on the inclination of the propagation vector. Hall currents introduce anisotropy into the gas, and are responsible for the behavior of the third type of wave. As the critical frequency for the third type of wave is approached, the gas particles achieve such great velocities that wave motion is destroyed. The kinetic and magnetic energies are both found to be equally divided into transverse and longitudinal components. Propagation is studied graphically for the conditions prevailing in H-II clouds and the Galactic Halo. (T.F.H.)

44305 SOURCES OF IONIZATION IN HIGH-PRESSURE GASES ABOVE 2000°K. D. W. George (Univ. of Sydney). Proc. Inst. Elec. Engrs. (London), 111: 1619-23(Sept. 1964).

Previous experiments with inert gases at high pressure between coaxial graphite electrodes, at temperatures above 2000°K, have shown unexpectedly high electric conductivities for quite small voltages across the electrodes. In the experiments the influences of electrode geometry and supply frequency are examined, and the gas pressure is steadily reduced until the classical regions of low pressure (several mmHg) and high vacuum (mean free path ≫ electrode spacing) are reached. Spectroscopic observations confirm the presence in the gas of seed impurities from the electrodes, and results are described for the deliberate addition to the gas of aluminum vapor as a seed element. (auth)

44306 ELECTRICAL BREAKDOWN OF GASES: THE SPATIO-TEMPORAL GROWTH OF IONIZATION IN FIELDS DISTORTED BY SPACE CHARGE. A. J. Davies, C. J. Evans, and F. Llewellyn Jones (University Coll. of Swansea, Wales). Proc. Roy. Soc. (London), Ser. A, 281: 164-83(Sept. 8, 1964).

A quantitative theoretical investigation is made of the spatio-temporal growth of ionization between plane parallel electrodes. A numerical method is described for integrating the ionization growth equations which enables the growth of the discharge to be traced from its initiation, in the uniform field region, as far as the transition to the glow discharge, involving space-charge-distorted fields, on the basis of the Townsend primary and secondary processes. A new method, more accurate than Poisson's equation in one dimension, is used to calculate the field distortion. Experimental data in hydrogen are analyzed, and it is shown that the theoretically predicted curves of voltage collapse agree with those observed experimentally when the field distortion is taken into consideration. The magnitudes of the various Townsend secondary coefficients required to describe in detail the voltage collapse and the observed formative times of breakdown depend on the cross-sectional area of the discharge. Limiting values of the secondary coefficients are given. (auth)

44307 COMPENSATION OF ION SPATIAL CHARGE BY ELECTRONS IN A MAGNETIC FIELD. V. N. Danilov. Radiotekhn. i Elektron., 9: 1530-3(Aug. 1964). (In Russian)

An analysis was made of high-vacuum space charge compensation by electrons emitted from a screen when an ion beam passes freely into a two-dimensional field $A_1 = A_2 = 0$, $A_3 = A(q^1,q^2)$, where $A_\alpha = (\alpha = 1, 2, 3)$ is a covariant component of the magnetic field vector; $q^\alpha(\alpha = 1, 2, 3)$ is a curvilinear coordinate system with a metric tensor in which $g^{\alpha\beta}$ satisfies the condition $g^{\alpha\beta} = 0$ if $\alpha \neq \beta = 3$; $g^{33} = g^{33}(q^1,q^2)$. The limiting conditions for the screen surface, electron and ion velocities, and electric field are given. Electron thermal velocities are not considered, screen current is limited by space charge, and the magnetic lines do not intersect the screen surface. A continuous solution of the problem was illustrated and analyzed. (R.V.J.)

44308 THE PRODUCTION OF HIGH QUASI-STATIONARY MAGNETIC FIELDS. Lothar Paul Warich (Technische Hochschule, Stuttgart). Z. Angew. Phys., 17: 348-50(July 1964). (In German)

A basic circuit diagram was constructed using relatively simple means. The circuit finds applications where high quasi-stationary magnetic fields are required. The arbitrary selection of the short circuit moment makes possible the use of this circuit for research in which short-time high overloads of ohmic or inductive loads occur. In many cases this simple type of circuit does not show the desired result. The circuit can be dismantled, however, at many points, so that a large part of all requirements can be fulfilled. (tr-auth)

44309 SINGLE-COMPONENT BEAMS OF LIKE-CHARGE PARTICLES. V. A. Syrovoi. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 3, 24-31(May-June 1964). (In Russian)

A single-component flow in the direction of one of the coördinate axes in an arbitrary orthogonal system was investigated, and the problem of a coördinate system permitting such a flow is analyzed. (R.V.J.)

44310 REFLECTION AND REFRACTION OF A WEAK ELECTROMAGNETIC WAVE BY A LAYER OF FIELD MOVING IN A NON-LINEAR MEDIUM. A. M. Glatsyuk (Khar'kov Inst. of Radiophysics and Electronics). Zh. Tekhn. Fiz., 34: 1345-50(Aug. 1964). (In Russian)

Reflection and refraction coefficients for a weak electromagnetic wave in a nonlinear medium with a strong moving field were calculated considering dispersion. Formulas were obtained for an electromagnetic wave in a ferrite with a shifting magnetic field of simple configuration. (R.V.J.)

44311 RADIATION OF A CHARGE FLYING THROUGH A CYLINDRICAL RESONATOR. O. A. Kolpakov and V. I. Kotov. Zh. Tekhn. Fiz., 34: 1387-91(Aug. 1964). (In Russian)

The energy emitted by a charge passing through a resonator was calculated. The obtained formulas, applied to the maximum case of a conducting screen with a cavity, agreed with published data. (tr-auth)

44312 ELLIPSOIDAL FUNCTION OF DISTRIBUTION IN MAGNETIC FIELDS. R. E. Movseyan (Moscow State Univ.). Zh. Tekhn. Fiz., 34: 1392-5(Aug. 1964). (In Russian)

An elliptic function was developed for charged particle precession in a non-stationary homogeneous magnetic field. The mean velocity of a charged particle beam in an external axial field was determined for the case in which the field and the temperature are functions of time. The mean velocity of rotation consists of ortho- and Larmor rotations. At $r \to \infty$ the beam rotates only at a Larmor frequency. The obtained general potential function contains additively the potential ortho- and Larmor rotation functions. It is shown that even under nonstationary conditions the elliptic constant is not a function of time. (R.V.J.)

44313 GEOMETRICAL ABERRATIONS OF THE THIRD ORDER IN ELECTROSTATIC TWO-DIMENSIONAL QUADRUPOLE LENSES. A. M. Strashkevich (Kiev Polytechnic Inst.). Zh. Tekhn. Fiz., 34: 1401-8(Aug. 1964). (In Russian)

Aberrations of arbitrary electrostatic two-dimensional systems with two-symmetry planes and two anti-symmetry planes were investigated. All developed aberration coefficients are expressed with trigonometric and hyperbolic functions. An investigation of third order aberrations indicated a substantial difference from axially-symmetric lens aberrations and permits calculations of Gauss and parallel planes. (tr-auth)

44314 INVESTIGATIONS OF AN INVERSE CORONA. B. N. Gorin (Inst. of Power Engineering, Moscow). Zh. Tekhn. Fiz., 34: 1511-20(Aug. 1964). (In Russian)

Data are given on the neutralization of saturated volume charge at the cutoff of corona electrodes. Volt-amp characteristics and oscillogram integrals for the discharge were scanned in addition to optical scanning of direct and reverse corona. At the negative cutoff 80% of the volume charge is neutralized. Moreover, neutralization takes place simultaneously with reduced potential on the electrode. The averaged distribution of volume charge and the potential gradient in the discharge are given as well as a description of the reverse corona process. (tr-auth)

44315 COLLECTED PAPERS OF P. L. KAPITZA. VOLUME I, 1916-1934. D. ter Haar, ed. A Pergamon Press Book. New York, The Macmillan Company, 1964. 516p. $20.00.

Papers (33) are included dealing with magnetostriction, measurement and production of strong magnetic fields, Zeeman effect in strong magnetic fields, effects of strong magnetic fields on electric conductivity and magnetic properties, liquefaction of helium and hydrogen, x-ray emission and reflection, preparation of Wollaston fibers, electron inertia in molecular ampere currents, atomic magnetic moments, and alpha and beta trajectories. (D.C.W.)

44316 HEAT TRANSFER IN MAGNETOHYDRODYNAMIC FLOW IN AN ENTRANCE SECTION. A. M. Dhanak (Michigan State Univ., East Lansing). New York, American Society of Mechanical Engineers, 1964, Paper No. 64-HT-30, 6p. $1.00. (CONF-644-17)

From 7th National Heat Transfer Conference, Cleveland, Aug. 1964.

Based on the Kármán-Pohlhausen method and the associated iterative procedures developed the analysis shows that the presence of a transverse magnetic field in the entrance section of a channel has significant effects on the velocity and pressure distributions, and on the displacement and momentum thicknesses. The calculations further reveal that the heat transfer from the channel, in contrast with the flat plate case, increases with the Hartmann number. This increase is, however, significant only at high Prandtl numbers. The influence of Joulean dissipation appears to be negligible for a Joulean parameter up to 1.0 and at a Prandtl number of unity. (auth)

Accelerators

Refer also to abstracts 43886, 43931, and 44772.

44317 (AECL-2059) AN INTENSE NEUTRON GENERATOR BASED ON A PROTON ACCELERATOR. G. A. Bartholomew, J. C. D. Milton, and E. W. Vogt (Atomic Energy of Canada Ltd., Chalk River, Ont.). Aug. 1964. 86p.

A study was made of the demand for a neutron facility with a thermal flux of $\geq 10^{16}$ n cm^{-2} sec^{-1} and of possible methods of producing such fluxes with existing or presently developing technology. Experimental projects proposed by neutron users requiring high fluxes call for neutrons of all energies from thermal to 100 Mev with both continuous-wave and pulsed output. Consideration of the heat generated in the source per useful neutron liberated shows that the (p,xn) reaction with 400 to 1000 Mev bombarding energies and heavy element targets (e.g., bismuth or lead) is capable of greater specific source strength than other possible methods realizable within the time scale. A preliminary parameter optimization carried through for the accelerator currently promising greatest economy (the separated-orbit cyclotron or S.O.C.) reveals that a facility delivering a proton beam of about 65 mamp at about 1 Bev would satisfy the flux requirement with a neutron cost significantly more favorable than that projected for a high-flux reactor. It is suggested that a proton storage ring providing post-acceleration pulsing of the proton beam should be developed for the facility. With this elaboration, and by taking advantage of the intrinsic microscopic pulse structure provided by the radio-frequency duty cycle, a very versatile source may be devised capable of producing multiple beams of continuous and pulsed neutrons with a wide range of energies and pulse widths. The source promises to be of great value for high flux irradiations and as a pilot facility for advanced reactor technology. The proposed proton accelerator also constitutes a meson source capable of producing beams of π and μ mesons and of neutrinos orders of magnitude more intense than those of any accelerator presently in use. These beams, which can be produced simultaneously with the neutron beams, open vast areas of new research in fundamental nuclear structure, elementary particle physics, and perhaps also in biology and medicine. (auth)

44318 (CERN-64-41) CONTRIBUTIONS TO THE THEORY OF THE BEAM GUIDE. E. Regenstreif (Rennes, France. Université. Faculté des Sciences and European Organization for Nuclear Research, Geneva). Sept. 24, 1964. 43p.

The theory of charged-particle motion in a beam guide is considered. In the guide, an axisymmetric magnetic field transports the particles over great distances. A coaxial transmission line fed with d-c or pulsed current plays the role of the focusing channel. (R.E.U.)

44319 (LA-DC-6545) COUPLED RESONATOR MODEL OF LINEAR ACCELERATOR TANKS. D. E. Nagle (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 14p. (CONF-650-7)

From Linear Accelerator Conference, Madison, Wis., July 1964.

A coupled-resonator model of the resonant tanks of a linac was used to analyze experimental results on phase shifts, perturbation effects, and locking phenomena. The relation between ring and chain was used. (R.E.U.)

44320 (NP-14345) MONITORIROVANIE SBROSA CHASTITS NA VNOTRENNYUYU MISHEN-SINKHROFAZOTRONA S POMOSHCH'YU IONIZATSIONNOI KAMERY. (Monitoring Particle Incidence on Target In a Synchrophasotron With the Aid of an Ionization Chamber). I. I. Levintov, V. P. Kanauets, B. V. Morozov, and N. A. Nikiforov (Akademiya Nauk S.S.S.R. Institut Teoreticheskoi i Eksperimental'noi Fiziki, Moscow and U.S.S.R. Sovet Ministrov. Gosudarstvennyi Komitet po Ispol'zovaniyu Atomnoi Energii). 1964. 8p.

A miniature portable ionization chamber was used for monitoring particle incidence on a target inside of a synchrophasotron. Descriptions are given of the design and characteristics of the chamber. (tr-auth)

44321 (SLAC-PUB-48) HIGH-POWER, PERMANENT-MAGNET-FOCUSED, S-BAND KLYSTRON FOR LINEAR ACCELERATOR USE. George K. Merdinina and J. V. Lebacqz (Stanford Univ., Calif. Stanford Linear Accelerator Center). Sept. 1964. Contract AT(04-3)-326. 17p. (CONF-719-2)

From 5th International Conference on Microwave Tubes, Paris, Sept. 1964.

The development of high-power s-band klystron tubes for the Stanford Linear Accelerator is discussed. The klystron is permanent-magnet-focused, and is designed to provide 24 Mw (peak) at 2856-Mc with an r-f pulse width of 2.5 μsec and repetition rate of 60 to 360 pps. Experimental tests and partial fulfillment of design objectives are given for the following design points: electron gun, interaction space, collector, output window, and permanent magnet. (R.E.U.)

44322 (SLAC-PUB-49) HIGH-POWER MICROWAVE WINDOWS. J. Jasberg and J. V. Lebacqz (Stanford Univ., Calif. Stanford Linear Accelerator Center). Sept. 1964. Contract AT(04-3)-326. 22p. (CONF-719-1)

From 5th International Conference on Microwave Tubes, Paris, Sept. 1964.

Failure modes in windows of klystrons were studied experimentally. Circular disk structures normal to the waveguide axis were studied at a single frequency, 2856 Mcps, with high vacuum at both the tube and load sides. The pulse length was 2.5 μsec, with repetition frequencies varying from 60 to 360 pulses per second. Power levels up to 175 Mw-peak and 160 kw-average were used. Window tests were performed not on klystrons directly, but in two resonant rings or in two cavities. The apparatus and results are described. (R.E.U.)

44323 EJECTION OF THE INTERNAL BEAM OF A SYNCHROTRON. Karl Helmut Reich (CERN, Geneva). Ind. At., 8: No. 7-8, 73-86(1964). (In French)

The respective advantages of inside and outside targets are listed, and the various methods for the ejection of a beam of accelerated particles in a synchrotron are dis-

cussed. The method of controlled excitation of a resonance of betatron oscillations is explained. A brief account of the technical problems encountered in the design and construction of the special magnets used for the systems of ejection is given. (auth)

44324 THE CURRENT TRANSMISSION OF A PERIODIC ELECTROSTATIC LENS SYSTEM. W. Huizenga and W. Schuurman (FOM-Instituut voor Plasma-Fysica, Jutphaas, Holland). J. Nuclear Energy, Pt. C, 6: 493-504 (Sept.-Oct. 1964).

The maximum ion or electron current that can be transmitted by an element of an infinitely periodic system of uni-potential lenses is investigated. Approximate formulas are derived for the maximum transmitted current and the increase of the beam diameter in the midplane of the lens. Numerical examples are given which show the dependence of the current and beam amplitude on the lens voltage and on the geometry of the electrode configuration. The results are in agreement with a detailed calculation of the trajectory of a boundary particle, carried out for one particular case. (auth)

44325 A BUNCHING AND CHOPPING SYSTEM FOR THE GENERATION OF SHORT DURATION ION BURSTS. J. H. Anderson and D. Swann (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 30: 1-22(Nov. 1964).

A system is described for applying bunching and chopping to a d-c, ion beam in order to generate very short bursts suitable for injection into a high-energy accelerator. Basic equations relating to the bunching and chopping of a d-c ion beam are given, and a method of observing the very fast current wave forms of the ion bursts is described. Results obtained on a pulsed injector prior to installation on a tandem accelerator are discussed. Recorded wave forms are included of ion bursts of duration 2 nsec with peak current gain ratios of better than 20:1 at a repetition rate of 5 Mc/s. (auth)

44326 A PULSED NEGATIVE ION BEAM INJECTOR. D. Dandy and D. P. Hammond (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 30: 23-33(Nov. 1964).

The design requirements on an injector for a tandem electrostatic accelerator are outlined, together with a simplified bunching and chopping theory. A system incorporating chopping and klystron bunching of an ion beam from a duoplasmatron source is described, which produces bursts of 2 nsec width at half height. R-f sources are used to produce heavy negative ion beams. (D.C.W.)

44327 SMALL HOODED-ARC SOURCES. D. J. Clark and P. S. Rogers (National Inst. for Research in Nuclear Science, Chilton, Berks, Eng.). Nucl. Instr. Methods, 30: 138-40(Nov. 1964).

Hooded-arc sources with rather small chimney diameters were tested in a small sector-focussed cyclotron to determine their suitability for synchrocyclotron use. The results are presented, and their use in synchrocyclotrons is discussed. (D.C.W.)

44328 SOURCE EXCHANGER FOR AN ELECTROSTATIC ACCELERATOR. C. P. Browne, A. L. Schaller, W. C. Miller, and S. E. Darden (Univ. of Notre Dame, Ind.). Nucl. Instr. Methods, 30: 145-7(Nov. 1964).

A device is described which allows an r-f ion source to be exchanged with an electron gun in the terminal of a pressure electrostatic accelerator without opening the pressure tank. The polarity of the accelerator may thus be changed by remote control. Conversion from positive ion acceleration to acceleration of large, well-focused electron beams is achieved in less than 30 min. (auth)

44329 EFFECTS OF SPACE CHARGE ON PARTICLE PHASE OSCILLATIONS IN IONIC LINEAR ACCELERATORS. I. M. Kapchinskii and A. S. Konrod (Inst. of Theoretical and Experimental Physics, Erivan). Pribory i Tekhn. Eksperim., No. 3, 26-31(May-June 1964). (In Russian)

An integral equation is derived for the potential of the self-conjugate Coulomb field of a beam. The equation is solved numerically and holds for any relationship between the transverse and longitudinal dimensions of the bunches. The dimensions of the region of phase stability, the frequency of the phase fluctuations, the average beam current, and other parameters are determined as a function of the maximum current in a bunch. The limitation imposed on the beam current by the longitudinal dispersion is compared with the limitation associated with transverse dispersion in a strong focusing accelerator. (auth)

44330 ON THE METHOD FOR MEASURING ACCELERATED CHARGE IN A BETATRON. V. A. Moskalev, V. G. Shestakov, B. V. Okulin, and Yu. M. Skvortsov. Pribory i Tekhn. Eksperim., No. 3, 32-3(May-June 1964). (In Russian)

The accelerated electron charge can be measured directly using a target or indirectly using an inductance or capacitance transducer. A method combining direct and indirect measurement is proposed. The current pulse with a target and the signal induced on a special electrode indicator are measured simultaneously. For energies less than 1 Mev the amplitude of the signal from the electrode indicator is calibrated directly in terms of the charge measured with the target and then is used to measure the charge of the signal from the electrode for any energy. (auth)

44331 PULSED BETATRON ACCELERATION IN A RING PHASATRON. S. S. Semenov (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 3, 113-15(May-June 1964). (In Russian)

An electric scheme for pulse injection in the symmetrical ring phasatron is described, which enables current pulses of like or alternate polarity in the excitation winding to be obtained. For particle acceleration in one direction, the operating efficiency of the accelerator is twice that calculated for the reverse half wave of the charge-exchange current of a condenser battery. The direct and reverse current half waves are identical due to automatic two-half-period undercharge of the condenser battery from a single rectifier. The interval between the half waves can be practically unboundedly large. The scheme can be used in apparatus for the study of plasma, for pulsed feed to electromagnets, in pulsed electrical drives, etc. (tr-auth)

44332 GENERATOR WITH FREQUENCY MODULATIONS ON FERRITE-FILLED LINES. S. S. Semenov (Inst. of Physics, Academy of Sciences, USSR). Pribory i Tekhn. Eksperim., No. 3, 116-18(May-June 1964). (In Russian)

A 1-kv f-m generator in which the lengths of coaxial lines filled with ferrite serve as resonance contours is described. Replotting by frequency in the range 15 to 35 Mc is produced by field magnetization of the ferrite. The generator is intended for compensation of the energy loss by radiation during storage of neighboring beams in the symmetrical ring phasatron and also for experimental study of the acceleration modes. (tr-auth)

44333 A DEVICE FOR GLUING ACCELERATOR VACUUM CHAMBERS. S. P. Bugaev and V. P. Ponomarev

(Tomsk Pedagogical Inst., USSR). Pribory i Tekhn. Eksperim., No. 3, 215(May-June 1964). (In Russian)

A simple device is described which enables all the sections of the chamber to be glued together simultaneously using an adhesive with an epoxide resin base and containing porcelain powder, dibutyl phthalate, and polyethylenepolyamine. The times required for this and previous methods of gluing are compared. (M.J.T.)

44334 PROTON-SYNCHROTRON DEVELOPMENT IN BRITAIN. G. C. Barney (Univ. of Birmingham, Eng.). Proc. Inst. Elec. Engrs. (London), 111: 1624(Sept. 1964).

The history and current development programs for the proton synchroton at the University of Birmingham are briefly outlined. (C.E.S.)

44335 ON THE HIGH-FREQUENCY INSTABILITY OF A CURVILINEAR ELECTRON BEAM MOVING IN A PERIODIC STATIC FIELD. A. V. Gaponov and M. I. Petelin. Radiotekhn. i Elektron., 9: 1368-73(Aug. 1964). (In Russian)

Interactions of electromagnetic waves in a waveguide with an accelerated curvilinear electron current focused by periodical electrostatic fields were investigated. The unperturbed electron motion in a static field is presented as a superimposed uniform longitudinal motion with velocity ν, fast oscillating motion with frequency $\Omega = 2\pi\nu/d$ (where d is the field period), and transverse drift oscillations acted upon by an effective averaged field. It is shown that the increment of high frequency field takes place during electromagnetic wave resonance interactions with the electron current on combined harmonics of fast and drift oscillation frequencies. (tr-auth)

44336 PARAMETERS OF AN ELECTRON BEAM EMITTING ELECTROMAGNETIC WAVES. G. I. Zhileiko. Radiotekhn. i Elektron., 9: 1374-85(Aug. 1964). (In Russian)

Characteristics of an accelerating device and electron beam parameters (the energy and energy straggling, cluster length, and finite beam current) used for generating electromagnetic oscillations were determined. The maximum and practical energies for electron harmonics were estimated. (tr-auth)

44337 FORMATION OF ASYMMETRICALLY DISTRIBUTED BEAMS IN A CHANNEL. N. D. Porev. Radiotekhn. i Elektron., 9: 1533-5(Aug. 1964). (In Russian)

Corrections are suggested for assymetrically distributed two-dimensional beams in a channel. The geometrical dimensions of the beam and channel and the distribution of the potential and electric field intensity are plotted. A schematic concept of the longitudinal beam cross section showing the surface oscillations is analyzed. (R.V.J.)

44338 THEORIES ON THE CAPTURE OF BETATRON-ACCELERATED PARTICLES. A. I. Zaboev. Sb. Nauchn. Rabot Kafedry Vyssh. Mat. Mosk. Inzh.-Fiz. Inst., No. 2, 94-111(1962). (In Russian)

A review on theories of injection of electrons into a betatron is presented. Special attention is given to a criticism of single-electron theories that do not take into account interaction of particles in a beam. The basic capture mechanism is considered as not being completely explained. It apparently consists of a rapid (2-4 cycles) redistribution of radial vibration energy between the particles in the injected beam. (Ref. Zh. Fiz.)

44339 ON THE FEASIBILITY OF BUILDING A MICROTRON WITH A PERMANENT MAGNET. V. A. Povitskii and A. I. Tsarapaev. Zh. Tekhn. Fiz., 34: 1462-5(Aug. 1964). (In Russian)

Construction of a microtron magnetic system using hard magnetic alloys with specific energy 150 to 250 × 10^3 erg/cm is discussed, and tentative calculations are given for a 5-Mev magnet system. (R.V.J.)

44340 METHOD AND APPARATUS FOR PHASING A LINEAR ACCELERATOR. David J. Goerz, Richard B. Neal, and Kenneth B. Mallory (to U. S. Atomic Energy Commission). U. S. Patent 3,147,396. Sept. 1, 1964.

A method and apparatus were developed for phasing a traveling-wave linear electron accelerator, and more particularly for the phasing of a traveling-wave linear electron accelerator utilizing phase comparison techniques to optimize the phase relationship between the beam and the traveling wave. Phasing is accomplished by observing the phase shift of a resultant traveling wave in an accelerator section when the electron beam is turned on, as compared to the traveling wave in the section with the beam off. Such a phase shift occurs only when the electron beam is not optimally phased with the traveling wave, hence the degree of phase shift is used as a measure of the degree to which the beam and traveling wave are out of phase. (AEC)

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Refer also to abstracts 44488, 44849, 44914, 44915, and 44916.

44341 (BNL-8217) ON THE PROBLEM OF DETECTING SOLAR NEUTRINOS. John N. Bahcall (California Inst. of Tech., Pasadena) and Raymond Davis, Jr. (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT(30-2)-Gen-16. 6p.

The possible detection of the solar neutrino flux by the reaction $^{37}Cl(\nu,e^-)^{37}Ar$ in a 100,000-gallon tank of perchloroethylene is discussed. The results could then be used to support a theory of nuclear energy generation in stars. The paper was/will be presented at a symposium on stellar evolution in New York. (R.E.U.)

44342 (COO-382-48) ON THE ORIGIN OF THE CANYON DIABLO NO. 2 AND NO. 3 METEORITES. Dieter Heymann (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies). July 1964. Contract AT(11-1)-382. 13p. (EFINS-64-38)

Measurements of ^3He, ^{21}Ne, and ^{38}Ar in nine Canyon Diablo meteorites indicate that the "anomalous" Canyon Diablo No. 2 was located inside the main mass of Canyon Diablo No. 1 when the latter struck the atmosphere. Canyon Diablo No. 3 probably originated from the main mass too, but the evidence is less certain. These conclusions speak against the view that the anomalous Canyon Diablo irons were either satellites of the main mass or distinct falls. It appears instead that significant chemical and structural variations existed in the nickel–iron phase of the meteorite parent body over distances of some tens of meters. (auth)

44343 ON THE LOSS OF MASS SUPERSTARS BY NEUTRINO EMISSION. Ya. B. Zel'dovich. Astron. Tsirkulyar., No. 250, 1-5(1963). (In Russian)

Neutrino emission during gravitational collapse of a super-heavy star was calculated. Mass losses from emission of annihilation neutrinos are $\leq 2-3\%$ for stars with 10,000 times the mass of the sun. This effect cannot have as a result the transformation of a considerable portion of gravitational energy into kinetic energy and consequently does not explain the powerful radio emission. The latter is probably associated with nonspherical movements occurring from gravitational instability. (Ref. Zh., Astron.)

44344 THE NEUTRINO RADIATION FROM STARS. Jerzy Jatczak. Astronautyka, 7: No. K (24), 23-9(1964). (In Polish)

The processes of neutrino and antineutrino production in stars are considered. There are the following principal processes: pair annihilation of neutrinos; photoproduction of neutrinos on electrons; transformation of two photons into neutrino pair; URCA process; neutrino bremsstrahlung; photoproduction of neutrinos on nucleus; transformation of photon into neutrino pair during photon-photon collision; and production of neutrino pair during recombination of ionized atoms. The energy carried off by neutrino radiation in high-temperature and high-density stars is greater than the photon luminosity. Neutrino cooling may be significant and in some cases even of decisive importance for the theory of white dwarfs and star evolution, and especially of the dynamics of supernova explosions. (auth)

44345 EXCHANGE OF MATTER AND PERIOD CHANGES IN CLOSE BINARY SYSTEMS. A. Kruszewski. Bull. Acad. Polon. Sci., Ser. Sci., Math., Astron. Phys., 12: 317-21(1964).

The problem of period changes resulting from the mass loss in double stars is considered. The problem is divided into three separate parts: the ejection of matter from the star, the perturbations of the orbital motion of the binary system introduced by the gravitational attraction of the detached matter, and the fall of the ejected matter on the star. (C.E.S.)

44346 THE TRANSFER OF MATTER AND THE VARIATIONS OF ELEMENTS IN CLOSE BINARY SYSTEMS. S. L. Piotrowski (Univ. of Warsaw). Bull. Acad. Polon. Sci., Ser. Sci., Math., Astron. Phys., 12: 323-7(1964).

Formulas for the changes of the shape and of the orientation of the relative orbit of a binary system when matter outflows from one component and escapes from the system or is falling back onto one of the components are presented. The considerations were limited to the case when the ejection of matter takes place in the plane of the orbit. No restrictions were made as to the eccentricity of the orbit. (C.E.S.)

44347 COHERENT ČERENKOV AND SYNCHROTRON INSTABILITIES OF SOLAR CORPUSCULAR STREAMS. M. S. Kovner and I. M. Chertok (Gorkii State Univ., USSR). Geomagnetism Aeronomy, 3: 817-21(1963).

It is shown that due to the existence of Landau absorption in the interplanetary medium the weak streams penetrating through plasma can be stable. The critical concentration of the stream $(N_s)_{cr}$, above which a stream becomes unstable in the space between the sun and earth, and the radiation frequency are dependent on the velocity of the stream. For example, streams with $v > 10^9$ cm/sec and $N_s \gtrsim 10$ cm^{-3} generate plasma waves in the range of frequencies 400–100 kc. The presence of absorption also makes it impossible for the stream to radiate ordinary and extraordinary waves. (auth)

44348 MAGNETIC FIELDS IN SOLAR PROMINENCES. B. A. Ioshpa (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 903-4(1963).

Measurements of the longitudinal component of the magnetic field in solar prominences were made using the Hβ line in the second order of the diffraction grating of the spectrograph (dispersion 0.8 Å/mm). The minimum detectable field in a prominence was ~50 gauss. A schematic representation of the development of the prominence is presented. (C.E.S.)

44349 ABOUT THE STRUCTURE AND DYNAMICS OF THE COSMIC SYSTEMS IN THE METAGALAXY. G. M. Idlis, Z. H. Kurmakaev, and T. B. Omarov. Izv. Akad. Nauk Kaz. SSR, Ser. Fiz.-Mat. Nauk, No. 1, 3-14(1963). (In Russian)

The uniform and isotropic radiation background in the expanding metagalaxy is taken into account for the problem of two bodies. In the equation of the relative motion (which is decreasing in time), additional forces such as the gravitation of the metagalactic background radiation, the reactive force, and the friction force appear; further, the effective gravitation constant has gradually vanishing dependence on time. The corresponding corrections to Newton's law of universal gravitation lie essentially outside of possible experimental determination (experimental data on gravitation shielding and decrease of gravitation in time being practically absent), but in the past these corrections played a noticeable role in explaining the structure (dimensions and masses) of the different cosmic systems and the peculiarities of their dynamics (stationarity or expansion). (auth)

44350 ISOTOPIC COMPOSITION AND CONCENTRATION OF MOLYBDENUM IN IRON METEORITES. G. W. Wetherill (Univ. of California, Los Angeles). J. Geophys. Res., 69: 4403-8(Oct. 15, 1964).

Isotopic composition and concentration of molybdenum in eight samples of meteoritic iron were measured by use of a "double spike" isotopic dilution technique. No differences greater than 1% were found between the $^{92}Mo/^{100}Mo$ ratios of meteoritic and terrestrial Mo. The concentration of Mo in all but nickel-rich ataxites fell in the range 6 to 8 ppm, whereas the two nickel-rich ataxites analyzed fell outside this range. One of these, Weaver Mountains, contained over 30 ppm. The isotopic composition of terrestrial Mo was discussed. (auth)

44351 MAGNETIC FLUX TUBES AND CONVECTION IN THE SUN. N. O. Weiss (Culham Lab., Abingdon, Berks, Eng.). Monthly Notices Roy. Astron. Soc., 128: 225-35 (1964).

Convection in the sun is apparently cellular, and the convective velocities can be estimated. The interaction of cellular convection with a weak magnetic field leads to concentrated ropes of flux in the convective zone with fields of about 5000 gauss and fluxes of 10^{21} maxwells in agreement with observation. These flux tubes tend to float outward from the center of the sun. The magnetic pressure associated with the fields required to halt photospheric convection is comparable with the gas pressure; therefore, fields will generally be diffuse as in bipolar magnetic regions. Occasionally the flux is concentrated to form a sunspot, but the cooling is insignificant at more than 1000 km below the surface of the sun. (auth)

44352 A NOTE ON GIAO'S THEORY OF COSMOLOGICAL MODELS. A. H. Klotz (Univ. of Liverpool). Monthly Notices Roy. Astron. Soc., 128: 255-9(1964).

The basic assumptions of Giao's theory of cosmological models are discussed and restated in a form permitting an immediate geometrical interpretation. It is shown how Giao's method can be amended to admit cosmological models in Einstein spaces and of Schwarzschild type. (auth)

44353 ELECTROMAGNETIC WAVES FROM VERY DENSE STARS. F. Hoyle, J. V. Narlikar, and J. A. Wheeler (Cambridge Univ , Eng.). Nature, 203: 914-16 (Aug. 29, 1964).

A neutron star is thought to be formed catastrophically, probably through the free fall collapse of a supernova. This means that such a star does not arrive gently at its stable configuration. Large dynamical velocities are developed and there must be oscillations about the stable configuration. It is postulated that the dynamical

energy of oscillation is dissipated through the emission of electromagnetic waves. (C.E.S.)

44354 OBSERVATIONS OF SOLAR X-RAY EMISSION IN THE BAND 44-60 Å FROM U. S. NAVAL RESEARCH LABORATORY SATELLITE 1963-21-C. L. Thomas (Dept. of Scientific and Industrial Research, Slough, Bucks, Eng.). Nature, 203: 962-3(Aug. 29, 1964).

Observations indicate that the flux of solar x rays in the band 44-60 Å during the period of low solar activity was near 8×10^{-2} erg cm^{-2} sec^{-1} This value lies within the range of values found at sunspot minimum and maximum conditions. Measurements made near 190 km show little evidence of atmospheric absorption except near sunrise and sunset. (C.E.S.)

44355 THE MYSTERY OF THE COSMIC HELIUM ABUNDANCE. F. Hoyle and R. J. Tayler (Cambridge Univ., Eng.). Nature, 203: 1108-10(Sept. 12, 1964).

An attempt is made to explain the presence of helium in a ratio by mass to hydrogen of about 1:2 in the universe. It is concluded that either the universe has had at least one high-temperature, high-density phase or that massive objects must play a larger part in the astrophysical evolution than was previously supposed. (C.E.S.)

44356 SPECTRAL EVIDENCE ON THE ORIGIN OF TYPE I SOLAR RADIO STORMS AND THE CORONAL MAGNETIC FIELD. J. P. Wild (Commonwealth Scientific and Industrial Research Organization, Sydney) and A. Tlamicha. Nature, 203: 1128-30(Sept. 12, 1964).

A particular class of systematic macroscopic features which were found to be repeatedly evident on the spectral records during a solar cycle is discussed. The feature is the occurrence of bursts grouped together in tens or hundreds to form narrow-band chains with durations of the order of one or several minutes and band-widths of the order of 10 Mc. (C.E.S.)

44357 CONTENT OF LEAD IN THE EARTH'S INITIAL CHONDRITE-LIKE OXIDE MASS AND THE PARTITION COEFFICIENT OF LEAD FOR CRYSTALLIZATION OF SILICATE MELT. Akimasa Masuda (Tokyo Univ.). Nature, 203: 1161-2(Sept. 12, 1964).

Equations are derived which relate the concentrations of thorium, uranium, and lead in a liquid-type material such as basalt, the concentrations of thorium, uranium, and lead in average chondritic oxide mass which is assumed to be nearly equal to the source material of the earth's oxide sphere, and the partition coefficients for thorium, uranium, and lead. The equations are derived from a rather rough, but necessary, assumption that the partition coefficients of minor elements between the just-formed crystals and the coexisting silicate melt are constant during the whole process of solidification of melt. (C.E.S.)

44358 CHLORINE-36 PRODUCED BY NEUTRON CAPTURE IN METEORITES. P. S. Goel (Carnegie Inst. of Tech., Pittsburgh). Nature, 203: 1162-3(Sept. 12, 1964).

The results of experiments that show that in large iron meteorites the production of ^{36}Cl can take place via the reaction $^{35}Cl(n,\gamma)^{36}Cl$ on the lawrencite inclusions in the metal are presented. (C.E.S.)

44359 SOLAR ORIGIN OF THE INTERPLANETARY MAGNETIC FIELD. Norman F. Ness (Goddard Space Flight Center, Greenbelt, Md.) and John M. Wilcox. Phys. Rev. Letters, 13: 461-4(Oct. 12, 1964).

Measurements made on the interplanetary magnetic field at 1 au using the IMP-1 satellite were compared with solar magnetograph observations of the photospheric magnetic fields as measured at the Mt. Wilson Observatory. The results indicate that during three solar rotations near the minimum of the solar cycle, some magnetic field lines passing through the photosphere near the center of the visible disk are dragged out by the solar wind to become part of the nearby interplanetary field. (D.C.W.)

44360 SOMETHING NEW UNDER THE QUIET SUN. Martin A. Pomerantz (Bartol Research Foundation, Philadelphia). Phys. Today, 17: No. 10, 19-22; 24-8; 30-1(Oct. 1964).

The objectives of the IQSY program are indicated; and the research programs in meteorology, geomagnetism, aurora, airglow, ionospheric physics, cosmic rays and trapped particles, aeronomy, and the sun and interplanetary medium are outlined, with reference to specific US projects. (D.C.W.)

44361 THEORETICAL MODELS OF CYTHEREAN AND MARTIAN UPPER ATMOSPHERES. I. DISSOCIATION LAYERS. Mikio Shimizu (Ochanomizu Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 31: 1153-5(June 1964).

The absorption of solar ultraviolet radiation and the concentrations of gases were calculated for isothermal atmospheres, taking into account recent data on the ultraviolet radiation and the recombination rates of atmospheric constituents. (D.C.W.)

44362 ON THE FORMATION OF GALAXIES AND THEIR MAGNETIC FIELDS IN A STEADY STATE UNIVERSE. D. W. Sciama. Quart. J. Roy. Astron. Soc., 5: 196-213(Sept. 1964).

Galaxy formation in a steady-state universe is studied, including thermal and magnetic forces along with the gravitational forces. The kinetic temperature of the intergalactic gas is estimated to be about 10^5 °K, a level that might be maintained by cosmic ray heating. At this temperature the gas is thermally unstable against the formation of condensations of galactic mass in a time $\sim 10^{10}$ years. Large galaxy clusters cannot form spontaneously, but can grow from smaller ones by gravitational accretion followed by thermal instability. The steady-state concentration of galaxies may be determined by a balance between the rate of galaxy formation and the rate of cosmic ray heating. Galaxy clusters may be pervaded by a magnetic field whose energy is in approximate equipartition with the kinetic energy of the galaxies, since this is probably a self-propagating feature of a steady state universe. The evolution of a protogalaxy in the cluster may be critically affected by this magnetic field. It is suggested that galactic magnetic fields may themselves arise through this self-propagation mechanism rather than by being spontaneously generated in localized regions. (auth)

44363 ON ONE FORM OF EINSTEIN'S EQUATIONS FOR A SPHERICALLY SYMMETRICAL MOTION OF A CONTINUOUS MEDIUM. M. A. Podurets. Soviet Astron.-AJ (English Transl.), 8: 19-22(July-Aug. 1964). Translated from Astron. Zh., 41: 28-32(Jan.-Feb. 1964).

The system of gravitational equations is brought to a form convenient for numerical calculations. The mass of an assembly of particles, located inside a variable radius R is introduced explicitly into the system. This makes it possible to obtain a computing scheme in which the mass of the whole star is automatically conserved. The limiting transition to classical hydrodynamics is discussed. (auth)

44364 EMISSION OF MAGNETOACOUSTIC WAVES IN THE MOTION OF STARS IN COSMIC SPACE. V. P. Dokuchaev (Gor'kii State Univ., USSR). Soviet Astron.-AJ (English Transl.), 8: 23-31(July-Aug. 1964). Translated from Astron. Zh., 41: 33-43(Jan.-Feb. 1964).

The gravitational and corpuscular interaction between a moving star and an interstellar ionized magnetoactive gas

is discussed. It is shown that the star emits magneto-acoustic waves by Cherenkov radiation. The most efficient mechanism of exciting these waves is found to be the stellar wind which ejects the gas belonging to the outlying layers of the stellar atmospheres. (auth)

44365 ENERGY TRANSFER FROM A POINT EXPLOSION WITHIN A STAR. V. G. Borbatskii (Leningrad State Univ.). Soviet Astron.-AJ (English Transl.), 8: 38-44 (July-Aug. 1964). Translated from Astron. Zh., 41: 53-62 (Jan.-Feb. 1964).

An explosive release of energy somewhere inside a star will produce a shock wave. If the shock is not strong enough to propel the wave to the surface, a small superheated pocket of reduced density will form and move outward, by the Archimedes principle, into less dense layers. The motion of a sphere containing the explosive energy is considered, with allowance for adiabatic expansion and a variable radius due to propagation of a thermal wave. Computations show this transfer mechanism to be efficient for type dM stars. If about 10^{33} erg is released in the explosion, the sphere will move from the central region to the outer layers of a dM4 star in approximately 10^4 sec. (auth)

44366 THE n_e AND T RELATION IN THE TRANSITION REGION BETWEEN THE CHROMOSPHERE AND CORONA. M. A. Livshits and G. M. Nikol'skii (Inst. of Terrestrial Magnetism, the Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Soviet Astron.-AJ (English Transl.), 8: 54-7(July-Aug. 1964). Translated from Astron. Zh., 41: 75-9(Jan.-Feb. 1964).

The law $n_e^{2.5}T$ = const found for the solar transition region is generalized for the atmospheres of stable stars. It is assumed that the source of cooling of the transition region is line emission by highly ionized atoms. This cooling is compensated by the dissipation energy of weak shock waves. It therefore follows that in the first approximation this law holds for the transition regions of stable stars. Some peculiarities of the transition region are discussed. (auth)

44367 DETERMINATION OF COMPONENTS OF TOTAL VECTOR OF SOLAR MAGNETIC FIELD STRENGTH BY MEANS OF AN ELECTRONIC COMPUTER. A. D. Bazarzhapov. Soviet Astron.-AJ (English Transl.), 8: 66-70(July-Aug. 1964). Translated from Astron. Zh., 41: 90-6(Jan.-Feb. 1964).

An algorithm for the problem of determining the absolute value of the total vector of the magnetic field strength of the solar field, the longitudinal and transverse field components, the angle of inclination of the field strength vector to the line of sight, and the azimuth of the transverse field component, is described. A description is given of a program for running this algorithm on a BESM-2 digital computer. The results of computer calculations and computations by nomograms are reported, and are found to fit well within the range of permissible errors. The study completed confirms that the use of computers means not only enormous savings in computing time (by a factor of about 80 in the improvement over the nomogram method for computing the solar field), but also the possibility of improved automation of data reduction processes, including mapping of the solar magnetic fields. (auth)

44368 THE RESTRICTED PROBLEM OF PERTURBED MOTION OF TWO BODIES WITH VARIABLE MASS. T. B. Omarov (Astrophysical Inst., Academy of Sciences, Kazakh SSR). Soviet Astron.-AJ (English Transl.), 8: 127-31(July-Aug. 1964). Translated from Astron. Zh., 41: 170-5(Jan.-Feb. 1964).

The restricted problem of two bodies with variable mass in the presence of a small force additional to the Newtonian interaction in the most general form. It is shown that at permissible rates of mass variation of binary systems the force is extremely small practically during all of the time of motion as compared to the modulus of the resultant of the forces. The vector differential equation correspondingly transforms to six occulating elements of motion. (auth)

44369 REMARKS ON "RADIO STARS." I. S. Shklovskii (Sternberg Astronomical Inst., USSR). Soviet Astron.-AJ (English Transl.), 8: 132-3(July-Aug. 1964). Translated from Astron. Zh., 41: 176-8(Jan.-Feb. 1964).

Estimates of the mass and size of the envelopes surrounding the so-called radio stars indicate that these objects are remnants of the explosion of ultramassive bodies. The inverse Compton effect plays a major role. The mechanism for generating the relativistic particles is discussed. (auth)

44370 SPECTRAL ENERGY DISTRIBUTION NEAR THE BALMER LIMIT FOR NONSTABLE STARS. I. G. Kolesnik and D. A. Frank-Kamenetskii (Central Astronomical Observatory, Academy of Sciences, Ukrainian SSR). Soviet Astron.-AJ (English Transl.), 8: 134-5(July-Aug. 1964). Translated from Astron. Zh., 41: 178-81(Jan.-Feb. 1964).

Assuming that the observed nonthermal spectra of nonstable stars originate in nonequilibrium plasma, a theoretical energy distribution is computed. Comparison with available observations shows that this mechanism can explain the spectra. (auth)

44371 THE PHYSICS OF SOLAR FLARES. Proceedings of AAS-NASA Symposium Held at the Goddard Space Flight Center, Greenbelt, Maryland, October 28-30, 1963. Wilmont N. Hess, ed. Washington, D. C., National Aeronautics and Space Administration, 1964. 473p. (NASA-SP-50). $3.25(GPO).

Separate abstracts were prepared for 49 of the 54 papers presented; two were previously included in NSA (17: 12922 and 18: 7830) and the remaining three are comments on solar gamma rays, solar wind, and solar flares The conference is divided into two major parts: observations and theory. (R.E.U.)

For abstracts of individual papers see: 44372, 44373, 44374, 44375, 44376, 44377, 44378, 44379, 44380, 44381, 44382, 44383, 44384, 44385, 44386, 44387, 44388, 44389, 44390, 44391, 44392, 44393, 44394, 44395, 44396, 44397, 44398, 44399, 44400, 44401, 44402, 44403, 44404, 44405, 44406, 44407, 44408, 44409, 44410, 44411, 44412, 44413, 44414, 44415, 44416, 44417, 44914, 44915, and 44916.

44372 SOLAR FLARES: THEIR STRUCTURE, DEVELOPMENT, AND MOTION. Henry J. Smith (National Aeronautics and Space Administration, Washington, D. C.). p.1-14 of "Physics of Solar Flares," NASA-SP-50.

An introductory discussion is given of flare structure and classification. Various types of chromospheric flares are shown. (R.E.U.)

44373 MOVING MATERIAL ACCOMPANYING THE FLARE OF 1959 JULY $16^d21^h14^m$ UT. Helen W. Dodson and E. Ruth Hedeman (McMath-Hulbert Observatory, Pontiac, Mich.). p.15-23 of "Physics of Solar Flares," NASA-SP-50.

Spectroheliogram analyses were made of the (3+) Hα flare at N16° W31°. The activation of relatively distant filaments was observed. (R.E.U.)

44374 OPTICAL CHARACTERISTICS OF CHROMOSPHERIC FLARES ASSOCIATED WITH TYPE IV RADIO BURSTS OR NOISE STORMS. Y. Avignon, C. Caroubalos, M. J. Martres-Tropé, and M. Pick (Observatoire de Paris,

Meudon, France). p.25-6 of "Physics of Solar Flares," NASA-SP-50.

Some characteristics of solar flares and of the associated optical regions accompanied by radio emissions (long-lasting type IV radio bursts observed on meter wavelengths, or type I storm activity) are summarized. (R.E.U.)

44375 FLARE IMPORTANCE RATINGS—SOME HOPE FOR IMPROVEMENT. Constance S. Warwick (National Bureau of Standards, Boulder, Colo.). p.27-8 of "Physics of Solar Flares," NASA-SP-50.

44376 SPECTROGRAPHIC OBSERVATIONS. Harold Zirin (High Altitude Observatory, Boulder, Colo.). p.33-48 of "Physics of Solar Flares," NASA-SP-50.

Some problems associated with obtaining and analyzing solar flare spectrograms are discussed. The historical development of spectrography is discussed. (R.E.U.)

44377 TIME VARIATIONS IN THE SOLAR EXTREME ULTRAVIOLET SPECTRUM OBSERVED BY OSO I. Werner M. Neupert (Goddard Space Flight Center, Greenbelt, Md.). p.49-61 of "Physics of Solar Flares," NASA-SP-50.

Variations in the solar spectrum were observed from March to May 1962 using a grazing incidence spectrometer on the OSO I. Slowly varying components of the spectrum were analyzed: the lines observed were 284 Å (Fe XV), 304 Å (He II), and 335 Å (Fe XVI). Both quiescent and disturbed solar atmospheres were observed during the period. (R.E.U.)

44378 SOLAR FLARES IN THE LIGHT OF HYDROGEN LYMAN-ALPHA. Kenneth L. Hallam (Goddard Space Flight Center, Greenbelt, Md.). p.63-4 of "Physics of Solar Flares," NASA-SP-50.

The total solar flux of hydrogen Lyman-alpha was monitored using a spectrally selective gas ionization chamber on OSO I from March 7 to April 28, 1962. Solar flare enhancement of Hα was observed. (R.E.U.)

44379 BROADENING AND ASYMMETRY OF THE EMISSION LINES IN FLARES. Maria C. Ballario (Osservatorio Astrofisico di Arcetri, Florence). p.65-70 of "Physics of Solar Flares," NASA-SP-50.

The effects of postulated macroscopic motions in solar flares on broadening and asymmetry in emission lines are analyzed. Data from several observers are unified. 19 references. (R.E.U.)

44380 SOLAR FLARES AND THE LOOP PROMINENCE MECHANISM. John T. Jefferies (Joint Institute for Laboratory Astrophysics, Boulder, Colo.) and Frank Q. Orrall. p.71-6 of "Physics of Solar Flares," NASA-SP-50.

The formation of loop prominences above solar flares during their decline from maximum is discussed. The makeup of the loop (coronal condensation) is considered. (R.E.U.)

44381 MASS BALANCE IN FLARE LOOPS. Josip Kleczek (Sacramento Peak Observatory, Sunspot, N. Mex.). p.77-80 of "Physics of Solar Flares," NASA-SP-50.

The size, height, and velocity of all of the streamers of several loop systems through their lifetime were measured. Analysis indicates that coronal condensation cannot supply the material for the loops' formation. (R.E.U.)

44382 ON THE STARK BROADENING OF HIGH BALMER LINES EMITTED BY SOLAR FLARES. L. D. de Feiter (Netherlands Foundation for Radio Astronomy, Sterrenwacht Sonnenborgh, Utrecht, Netherlands). p.81-5 of "Physics of Solar Flares," NASA-SP-50.

The effects of the electrons on the Stark-broadening parameters from classical Holtsmark theory are analyzed. Halfwidth analysis was used for solar flare spectra to evaluate electron density profiles. (R.E.U.)

44383 MAGNETIC OBSERVATIONS RELATING TO SOLAR FLARES. Robert Howard (Carnegie Institution of Washington, D. C. and California Inst. of Tech., Pasadena). p.89-94 of "Physics of Solar Flares," NASA-SP-50.

Magnetic observations used in explaining solar flare phenomena are discussed. Sunspot magnetic fields, classifications, and areas, and their relation to flare activity are considered. (R.E.U.)

44384 ON THE BEHAVIOR OF MAGNETIC FIELDS ASSOCIATED WITH SOLAR FLARES. A. B. Severny (Severnyy) (Severnyi) (Crimean Astrophysical Observatory, P/O Nauchny, Crimea, USSR). p.95-101 of "Physics of Solar Flares," NASA-SP-50.

Isogauss contour maps of transverse solar fields were studied for behavior of magnetic fields during flares. (R.E.U.)

44385 ASSOCIATION OF FLARES WITH STATIONARY POINTS OF ZERO MAGNETIC FIELD. James Weddell (North American Aviation, Inc., Downey, Calif.). p.103-6 of "Physics of Solar Flares," NASA-SP-50.

Magnetographic observations of solar flare origins were studied, and results indicate that the stationarity of a zero-field point is almost sufficient for flare instigation. (R.E.U.)

44386 ON THE OBSERVABLE EFFECTS OF MAGNETIC ENERGY STORAGE AND RELEASE CONNECTED WITH SOLAR FLARES. Hermann U. Schmidt (Sacramento Peak Observatory, Sunspot, N. Mex.). p.107-14 of "Physics of Solar Flares," NASA-SP-50.

A classification of the possible magnetic changes in the solar atmosphere in terms of their observable effects is proposed. Ten magnetograms taken before and after the great flare of July 16, 1959, are used to compute the changes of the total flux and of the total magnetic energy in a current-free approximation; large and rapid changes are found. Two independent characteristic lengths of the field in this region are also derived. These do not exhibit comparable changes, but only a moderate expansion. This would suggest the existence of major changes in the total flux without corresponding changes in the geometrical distribution of this flux. Since the conductivity does not allow any appreciable dissipation or diffusion of flux, this interpretation implies an improbable coupling between the velocity field and the magnetic field. This discrepancy stresses the need for further observations. (auth)

44387 ENERGETIC X-RAY BURSTS FROM SOLAR FLARES. John R. Winckler (Univ. of Minnesota, Minneapolis). p.117-29 of "Physics of Solar Flares," NASA-SP-50.

Observations of x-ray bursts and their relation to high-energy processes in solar flares are discussed. (R.E.U.)

44388 SOLAR X RAYS: A COMPARISON WITH MICROWAVE RADIATION. W. A. White (Goddard Space Flight Center, Greenbelt, Md.). p.131-7 of "Physics of Solar Flares," NASA-SP-50.

Analysis of data from the OSO I satellite shows that solar x rays shortward of 10 angstroms exhibit a violent dynamic behavior, which, however, contains within it counterparts of the somewhat less dramatic behavior of the solar microwave flux. Specifically, the solar x-ray flux contains: (1) a slowly varying component, (2) "gradual rise and fall" bursts, and (3) impulsive bursts. The OSO I data show the first two to be related to their microwave counterparts, and the empirical relations are given in the paper. Observations at 10 Å of the third component (impulsive bursts) could not be associated directly with micro-

wave observations because of the extreme disparity in sensitivities of the two methods of observing this phenomenon. However, observations by Frost of solar x rays in the 20 to 100 kev region do show a direct counterpart of the microwave impulsive burst. (auth)

44389 COMMENTS ON HIGH ENERGY X-RAY BURSTS OBSERVED BY OSO I. Kenneth J. Frost (Goddard Space Flight Center, Greenbelt, Md.). p.139-43 of "Physics of Solar Flares," NASA-SP-50.

Instrumentation aboard the first Orbiting Solar Observatory observed five separate instances of high-energy x-ray bursts accompanying solar flares. The x-ray bursts were observed in the 20 to 100 kev range. Data on the types of flares producing the x-ray bursts and the associated microwave radio bursts are presented. (auth)

44390 SOLAR X-RAY EMISSION — NRL RESULTS. Herbert Friedman (Hulburt Center for Space Research, Naval Research Lab., Washington, D. C.). p.147-57 of "Physics of Solar Flares," NASA-SP-50.

Measurements of the line spectra from 1 to 25 Å, fan beam scans to resolve the dimensions of active regions, and spectroheliograms in the u-v lines of highly ionized coronal ions are reported. Data are given for flare x-ray bursts at 2 to 20 kev, and interpreted in terms of possible thermal mechanisms. (R.E.U.)

44391 THE SLOWLY VARYING COMPONENT OF SOLAR RADIO EMISSION. G. Swarup (Tata Inst. of Fundamental Research Bombay). p.179-98 of "Physics of Solar Flares," NASA-SP-50.

Correlations between solar radio emission at cm and dm wavelengths with sunspot area are presented. Theories of the origin of the radio emission are discussed. Observed associations between the slowly varying component (S-component) in the cm to dm range (thermal emission from quiet sun) and the flare activity of an active region are discussed. The high-resolution observations indicate that the S-component originates at 10^4 to 10^5 km above the photosphere in regions of high coronal densities and magnetic fields that lie above sunspots and plages. (R.E.U.)

44392 STUDY OF SOLAR NOISE STORMS AT 169 MC/S WITH THE AID OF THE NANCAY INTERFEROMETER. A. M. LeSqueren (Observatoire de Paris, Meudon, France). p.199-202 of "Physics of Solar Flares," NASA-SP-50.

Measurements of noise-storm center positions using the Nancay interferometer (precision of the order of the minute of arc) were used to study the connection between these storms and centers of optical activity. The relation between storm commencement and chromospheric flares, the connection between the sense of polarization of storms and the hemisphere in which the visible center associated with the coronal center is located, and the variation of the apparent position of the storms as a function of heliocentric longitude were studied. (R.E.U.)

44393 STUDY OF THE SLOWLY VARYING COMPONENT AT 9400 MC/S AS A FUNCTION OF SOLAR ACTIVITY. C. Caroubalos (Observatoire de Paris, Meudon, France). p.203-5 of "Physics of Solar Flares," NASA-SP-50.

Type IV bursts from centers of solar activity and their use in predicting geomagnetic activity are discussed. (R.E.U.)

44394 ACTIVE DARK FILAMENTS AND TYPE III BURSTS. Tatsuo Takakura and A. Tlamicha (Tokyo Astronomical Observatory). p.207-8 of "Physics of Solar Flares," NASA-SP-50.

In order to correlate active dark filaments (without flare) and type III bursts, active prominences and active filaments observed spectrohelioscopically were compared with radio activities observed with an interferometer and a polarimeter at 200 Mc. (R.E.U.)

44395 THE ASSOCIATION OF BREMSSTRAHLUNG X RAYS WITH EXPLOSIVE FLARES. Gail E. Moreton (Lockheed Solar Observatory, Burbank, Calif.). p.209-12 of "Physics of Solar Flares," NASA-SP-50.

Optical properties of flares associated with bremsstrahlung emission of x rays are shown to indicate sudden nonthermal energy processes occurring in a localized region of an otherwise normal flare, thus causing an "explosive" flare. (R.E.U.)

44396 A REVIEW OF SOLAR COSMIC RAY EVENTS. William R. Webber (Univ. of Minnesota, Minneapolis). p.215-55 of "Physics of Solar Flares," NASA-SP-50.

Cosmic radiation (>10 Mev) enhancement above galactic background is correlated with cm radiowave emission. Particle acceleration mechanisms in solar flare regions, and propagation of these particles through the inner solar system are discussed. (R.E.U.)

44397 THE ASSOCIATION OF ENERGETIC PARTICLES WITH SOLAR FLARES. John M. Malville (Univ. of Michigan, Ann Arbor). p.257-61 of "Physics of Solar Flares," NASA-SP-50.

The correlation between proton events and flares that produce type IV radio bursts is discussed. Other types of bursts are discussed, with energetic particle motions considered. (R.E.U.)

44398 CHARGE COMPOSITION OF ENERGETIC SOLAR PARTICLES. Carl E. Fichtel (Goddard Space Flight Center, Greenbelt, Md.). p.263-71 of "Physics of Solar Flares," NASA-SP-50.

Experimental observations on the composition of solar cosmic rays are used to discuss particle propagation in interplanetary space and solar composition. Of special interest is the multiply charged component (nuclear charge ≥ 2) of solar radiation. (R.E.U.)

44399 MARINER SOLAR WIND MEASUREMENT. Conway W. Snyder (Jet Propulsion Lab., Pasadena, Calif.). p.273-8 of "Physics of Solar Flares," NASA-SP-50.

Some data from Mariner II (1962 A-ρ1) on solar activity are correlated with geomagnetic disturbances. The sudden commencement and recurrent storms are considered as caused by streams of plasma that come, respectively, from solar flares and from M-regions not associated with flares. (R.E.U.)

44400 SOLAR SURFACE NUCLEAR REACTIONS. Edward L. Fireman (Smithsonian Institution, Cambridge, Mass.). p.279-84 of "Physics of Solar Flares," NASA-SP-50.

The high tritium and helium-3 content in Discoverer 17 (1960 o1) material indicates that nuclear reactions occurred on the solar surface during the November 12, 1960, flare. The ratio of helium-3 to tritium was approximately 70. If the tritium and the helium-3 are interpreted as the stripping of helium-4 flare particles in the solar atmosphere, the path length is at least 10 gm/cm^2. This lower limit on the path length is approximately the same as the upper limit, which is determined from the ratio of boron to carbon nuclei in the flare. The path length appears to be too restricted for the helium-3 and tritium to be produced solely by the stripping of helium-4 particles. It is more likely that the helium-3 and tritium are produced in a thermonuclear reaction. (auth)

44401 SOME PROPERTIES OF CORPUSCULAR STREAMS FROM THE CHROMOSPHERIC FLARES. E. R. Mustel and N. B. Egorova (Academy of Sciences, USSR). p.285-6 of "Physics of Solar Flares," NASA-SP-50.

An analysis was made of the longitudinal distribution of geomagnetically effective chromospheric flares on the visible disk of the sun from data collected from 1957 to 60 to obtain information on the motion of gases ejected from the flare. (R.E.U.)

44402 VELOCITY DEPENDENCE AND SOURCE SPECTRA OF SOLAR PROTON EVENTS. D. A. Bryant, T. L. Cline, U. D. Desai, and F. B. McDonald (Goddard Space Flight Center, Greenbelt, Md.). p.289-97 of "Physics of Solar Flares," NASA-SP-50.

Some data from Explorer 12 and 13 were used to describe four modes of propagation of solar protons to earth. The velocity dependence of one mode makes possible a determination of the energy spectrum of particles at the time of release from the sun. The modes are described in terms of particle velocity, motion of enhanced solar plasma, and rotation of the sun. (R.E.U.)

44403 CASE HISTORIES OF FLARES: THE LARGE FLARES OF JULY 11, 12, 18 AND 20, 1961. Anton Bruzek (Fraunhofer Institut, Freiburg i. B. and Sacramento Peak Observatory, N. Mex.). p.301-22 of "Physics of Solar Flares," NASA-SP-50.

Data were gathered and are analyzed for the series of large flares of July 11, 12, 18, and 20. The visible phenomena were studied from Hα photographs and flare and prominence films. Radio bursts and x ray emissions were analyzed. 39 references. (R.E.U.)

44404 AN ASSEMBLY OF FLARE OBSERVATIONS AS RELATED TO THEORY. K. O. Kiepenheuer (Fraunhofer Institut, Freiburg i. B.). p.323-31 of "Physics of Solar Flares," NASA-SP-50.

A description of the observed macroscopic configurations of flares, spot groups, and dark filaments is given. The possible sub-telescopic structure of flares is discussed. It is shown that the high-energy output of a flare (particle energies and radiation) must be produced in situ. The energy probably cannot be transferred to the flare's volume from the outside. To supply the energy, the assumption of the annihilation of a field of a few hundred gauss within the flare obviously cannot be avoided. The close relation between flares and filaments, as well as the activation of the associated filaments (increase of density and of internal turbulence) well before the optical onset of the flare, suggests that this activation is already part of the flare phenomenon. One could say that a flare represents a more violent form of the densification of hot coronal material into a cool filament. While the formation of a dark filament (prominence) takes hours, the flare is condensed within a few minutes. The Schlüter-Kippenhahn model of prominences gives some indications for such a type of instability. (auth)

44405 A SURVEY OF THE INTERPRETATIONS OF RADIO AND X-RAY BURSTS. Mokul R. Kundu (Cornell Univ., Ithaca, N. Y.). p.335-42 of "Physics of Solar Flares," NASA-SP-50.

A theoretical study of radio and x-ray emissions from solar flares was made to evaluate possible mechanisms of burst production such as: bremsstrahlung from solar plasma, gyro and synchrotron radiation from electrons in a magnetic field, and plasma waves in the solar atmosphere. (R.E.U.)

44406 TYPE III SOLAR RADIO BURSTS. Peter A. Sturrock (Stanford Univ., Calif.). p.357-64 of "Physics of Solar Flares," NASA-SP-50.

A theory of type III solar radio emission is presented. The observed frequency range of type III emissions is 600 to 5 Mc for the fundamental, the time duration being about 10 sec. The physical mechanisms are described: the electromagnetic waves are excited by flare electron beam interactions with the coronal plasma. (R.E.U.)

44407 SOME NOTES ON THE RELATIONS OF X-RAY, PARTICLE, AND RADIO EMISSION OF THE SUN DURING FLARES. Gerhard Elwert (Universität, Tübingen, Ger.). p.365-70 of "Physics of Solar Flares," NASA-SP-50.

A theoretical study was made of the relation between x-ray production, particle emission, and certain types of radio emission during solar flares. (R.E.U.)

44408 TYPE II BURSTS AND THE MAGNETIC FIELD IN THE CORONA. Tatsuo Takakura (Tokyo Astronomical Observatory). p.383-5 of "Physics of Solar Flares," NASA-SP-50.

Conditions necessary for the production of radio waves by Rayleigh scattering of the plasma waves in the corona were investigated. Band splitting and wave polarization were studied. (R.E.U.)

44409 MAGNETIC ENERGY SHEDDING IN THE SOLAR ATMOSPHERE. Thomas Gold (Cornell Univ., Ithaca, N. Y.). p.389-95 of "Physics of Solar Flares," NASA-SP-50.

The dissipation of magnetic energy in the solar atmosphere during plages and flares is discussed. (R.E.U.)

44410 THE ORIGIN OF SOLAR FLARES AND THE ACCELERATION OF CHARGED PARTICLES. Donat G. Wentzel (Univ. of Michigan Observatory, Ann Arbor). p.397-407 of "Physics of Solar Flares," NASA-SP-50.

Magnetic field energy storage and dissipation mechanisms are discussed. Charged-particle acceleration by electric fields in flares and related positrons is discussed. (R.E.U.)

44411 INSTABILITY PROBLEMS IN THE ORIGIN OF SOLAR FLARES. Peter A. Sweet (Glasgow Univ. Observatory). p.409-14 of "Physics of Solar Flares," NASA-SP-50.

The types of hydromagnetic instability, which could account for the sudden onset of flares, are discussed. Emphasis is on the possibility of a large-scale resistive instability. An outline is given of a method by which the existence of such a mode could be established theoretically. (auth)

44412 REMARKS ON THE DISCHARGE THEORY OF FLARES. James W. Dungey (Imperial Coll. of Science and Tech., London). p.415-16 of "Physics of Solar Flares," NASA-SP-50.

The growth rate of flares, particle acceleration in solar magnetic fields, and the topology of fields with neutral points as correlated with proton events are discussed. (R.E.U.)

44413 A MECHANISM FOR THE DISSIPATION OF THE MAGNETIC FIELD IN SOLAR FLARES. Radhe K. Jaggi (Goddard Space Flight Center, Greenbelt, Md.). p.419-23 of "Physics of Solar Flares," NASA-SP-50.

A mechanism by which energy is released in the chromosphere, leading to the initial production of a solar flare, is described. The release time for a flare must be of the order of 10^3 seconds. Finite conductivity instabilities were investigated as the possible mechanism. (R.E.U.)

44414 STABILITY OF THE SOLAR MAGNETIC FIELD IN THE REGION OF FLARES. James W. Warwick (High Altitude Observatory, Boulder, Colo.). p.441-2 of "Physics of Solar Flares," NASA-SP-50.

Magnetic field variations during solar flares are discussed. (R.E.U.)

44415 SOLAR MAGNETIC FIELDS AND SPACECRAFT OBSERVATIONS. Leverett Davis, Jr. (California Inst. of Tech., Pasadena). p.443-4 of "Physics of Solar Flares," NASA-SP-50.

Some indirect sources of information on the chromospheric magnetic fields and solar wind velocities are discussed. (R.E.U.)

44416 PRODUCTION OF GAMMA RAYS AND NEUTRONS IN SOLAR FLARE REGIONS. E. L. Chupp (Univ. of New Hampshire, Durham). p.445-9 of "Physics of Solar Flares," NASA-SP-50.

Theoretical estimates were made of neutron and gamma production as by-products of nuclear reactions in flare regions of the sun. (R.E.U.)

44417 A PROCESS FOR FLARES. Hugh Carmichael (Atomic Energy of Canada Ltd., Chalk River, Ont.). p.451-6 of "Physics of Solar Flares," NASA-SP-50.

A theoretical concept of flare production is discussed in which the flare energy is the mechanical energy of the solar wind stored temporarily by the magnetic field. (R.E.U.)

Atomic Physics

Refer also to abstracts 44170, 44171, 44749, 44750, 44797, and 44825.

44418 (ANL-6911) THE ELECTRONIC ENERGY LEVELS OF THE HEAVY ACTINIDES $Bk^{+3}(5f^8)$, $Cf^{+3}(5f^9)$, $Es^{+3}(5f^{10})$, AND $Fm^{+3}(5f^{11})$. P. R. Fields, B. G. Wybourne, and W. T. Carnall (Argonne National Lab., Ill.). July 1964. Contract W-31-109-eng-38. 10p.

An intermediate coupling calculation was performed, and results are tabulated for 0 to 30,000 cm^{-1}. Extrapolated data from lighter lanthanides were used. (R.E.U.)

44419 (BNL-7311) MAGNETIC STRUCTURES AND NEUTRON DIFFRACTION. L. M. Corliss (Brookhaven National Lab., Upton, N. Y.). [nd]. Contract AT-30-2-GEN-16. 17p.

Theoretical and experimental magnetic structure studies are reviewed. Some neutron diffraction investigations are included. 75 references. (R.E.U.)

44420 (GAMD-3631) NEUTRON SCATTERING AND THE FREQUENCY DISTRIBUTION IN A SOLID. D. E. Parks (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Nov. 1, 1962. Contract AT(04-3)-167. 6p.

The self part of the Van Hove scattering law was studied for the case of monatomic polycrystals whose internal atomic motions can be described by a superposition of harmonic lattice vibrations. (R.E.U.)

44421 (GCA-TR-64-1-N) PLANETARY PHYSICS. I. THE PHOTOIONIZATION OF ATOMIC OXYGEN. A. Dalgarno, R. J. W. Henry, and A. L. Stewart (Geophysics Corp. of America, Bedford, Mass.). Jan. 1964. Contract NASw-840. 33p. (NASA-CR-55949; N64-17689)

The formulation of a Hartree-Fock approximation for the final states of a transition involving the ejection of an outer or an inner shell electron from all ground state configurations $1s^22s^22p^3$ is presented, and the cross sections for the photoionization of atomic oxygen by radiation at wavelengths longer than 24 Å are calculated. (auth)

44422 (LA-DC-6091) ELECTRON-PHONON MATRIX ELEMENTS. David A. Liberman (Los Alamos Scientific Lab., N. Mex.). [nd]. Contract [W-7405-eng-36]. 5p.

Electron-phonon matrix elements were calculated from the products of the electron wave function and the wave function of the vibrating lattice. The method requires account of the screening of the ion-electron interaction by the plasma electrons of the lattice. (R.E.U.)

44423 (LA-DC-6117) A NEW EQUATION FOR ELECTRONS IN PERIODIC LATTICES. David Liberman (Los Alamos Scientific Lab., N. Mex.). [1961]. Contract [W-7405-eng-36]. 8p.

A generalization of the tight binding approximation leads to an equation for the function that replaces the atomic orbital in that method. For positive energies this function has the character of a scattered wave. (auth)

44424 (NAVWEPS-8490) QUANTUM MECHANICS OF HO_2. II. STANDARD LIST OF TWO ELECTRON INTEGRALS. D. S. Villars (Naval Ordnance Test Station, Inyokern (China Lake), Calif.). Mar. 1964 . 89p. (NOTS-TP-3460; AD-601121)

The report describes the basic theory for setting up standard lists of integrals to omit those combinations of parameters that would lead to zero values because of a selection rule and those lower order combinations that give integrals of replicate values. Descriptions are then given of four programs and their principal auxiliary subroutines or functions. Program PRPU generates the standard list for two-center integrals as a deck of cards. Program HIMN reads this deck and calls for computation of the two-center molecular integrals by a Harris program. Program ST02L translates nomenclature on output cards from the MI-DIAT two-center molecular integral program into one understood by the writer's subroutine IT1, finds locations where that integral belongs in the standard list and stores. The Wright-Pitzer main programs for AABC and ABAC three-center integrals were slightly modified to call a subroutine READ, which inputs the initial wave function parameters and rearranges them to present for processing by the Wright-Pitzer programs. READ also calls for promotion of indices to the set of next higher order. (auth)

44425 (ORNL-P-296) DIFFICULTIES IN APPLYING SEMIEMPIRICAL COUPLING RULES TO MAGNETIC STRUCTURES. M. K. Wilkinson (Oak Ridge National Lab., Tenn.). [1963]. Contract [W-7405-eng-26]. 17p. (CONF-690-2)

From Advanced Course on Magnetic Exchange Interaction on Transition Metal Compounds, Kjeller, Norway, Sept. 1964.

Semiempirical rules developed for analysis of indirect magnetic coupling between two magnetic cations were tested in compounds containing magnetic cations in octahedral lattice sites: rutile-type and hexagonal layer-type structures. Neutron-diffraction analyses are correlated with results of semiempirical rules. (R.E.U.)

44426 (UCRL-11538) NUCLEAR AND MAGNETIC RESONANCE STUDIES IN S-STATE IONS (thesis). H. Hollis Wickman (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 19, 1964. Contract W-7405-eng-48. 157p.

The S-state ions $Fe^{3+}(^6S_{\frac{5}{2}})$, $Eu^{2+}(^8S_{\frac{7}{2}})$, and $Cm^{3+}(^8S_{\frac{7}{2}})$ were investigated by means of Mössbauer or electron spin resonance experiments, or both. Nuclear resonance of ^{151}Eu

was employed to study the isomer shifts and internal fields in the ferromagnetic insulators EuO and EuS. These results, and isomer shifts for several other europium compounds, are correlated on the basis of core polarization. The temperature dependence of the internal field of EuO was obtained and compared with spin-wave and Weiss-field theories. Iron-57 was studied in the metallo-organics ferrichrome and ferrichrome A. In these paramagnetic compounds the long electronic relaxation time allows a nonvanishing hyperfine field to be observed by Mössbauer resonance. Electron spin resonance measurements with these compounds are also described. A crystal field model is developed which correlates the Mössbauer and electron spin resonance results. In addition, a simple theory for the effect of electronic relaxation on Mössbauer spectra is described and applied to the ferrichrome A results. The paramagnetic resonance of Cm^{3+} was observed in trichloride and ethylsulfate crystals. The large deviation of Cm^{3+} from S-state behavior was evidenced by the anisotropic g values found for this ion in the above crystals. Experiments with Cm^{3+} in the double nitrate lattice are also described. 83 references. (auth)

44427 (UCRL-11665) THE RADIO-FREQUENCY AND MICROWAVE SPECTRA OF LiBr AND LiI (thesis). Francis William Breivogel, Jr. (California. Univ., Berkeley. Lawrence Radiation Lab.). Sept. 18, 1964. Contract W-7405-eng-48. 80p.

The molecular-beam electric-resonance method has been used to obtain the radio-frequency and microwave spectra of $^{6}Li^{79}Br$, $^{6}Li^{81}Br$, and $^{6}Li^{127}I$ and the radio-frequency spectrum of $^{7}Li^{79}Br$. Values were obtained for the quadrupole coupling constants and spin-rotation constants for ^{79}Br in $^{6}Li^{79}Br$ and $^{7}Li^{79}Br$, for ^{81}Br in $^{6}Li^{81}Br$, for ^{127}I in $^{6}Li^{127}I$, and for ^{7}Li in $^{7}Li^{79}Br$. The molecular electric dipole moment was measured for $^{6}Li^{79}Br$ and $^{6}Li^{81}Br$ in the v = 0, 1, and 2 states, for $^{6}Li^{127}I$ in the v = 0 and v = 1 states, and for $^{7}Li^{79}Br$ in the v = 0 state. For $^{6}Li^{79}Br$ and $^{6}Li^{81}Br$ values were obtained for Y_{01}, Y_{11}, and Y_{21}. Values for Y_{01} and Y_{11} were obtained for $^{6}Li^{127}I$. A new computer program was written to interpret the spectra obtained. This program took into account second order quadrupole effects and the Stark-quadrupole interaction. An attempt was made to correlate the ionic polarizabilities of the alkali halides with the experimental dipole moments using an ionic model. (auth)

44428 LUMINESCENCE OF RARE GASES UNDER EXCITATION BY FAST ELECTRONS. W. Hanle, E. Kugler, and A. Schmillen (Universität, Giessen, Ger.). Ann. Physik (7), 13: 252-73(1964). (In German)

The rare gases Ne, Ar, Kr, and Xe were irradiated at pressures from 5 to 500 torr with electrons of 50 kev. The luminescence produced was investigated with the help of interference filters in a narrow spectral range, and the decay time was determined oscillographically or with a phase fluorimeter. The decay times measured in various regions of the spectrum were between 10^{-9} and 10^{-5} sec. The decays of arc lines, spark lines, and continua could be separated from each other. Insight is obtained into the elementary processes in luminescent excitation of rare gases. (tr-auth)

44429 SOME FLASH X-RAY LINES OF Dy, Zn, Cr AND V. Per Olof Schoerling (Uppsala Univ.). Arkiv Fysik, 27: 143-59(1964).

Some of the Dy L-lines and Zn, Cr, and V K-lines from an x-ray flash tube with low inductance were recorded photographically and compared with the same lines from an ordinary x-ray tube. In the flash x-ray spectrum of Zn the $K\beta_{1,3}$ line was broadened on the high energy side. In the flash x-ray spectra of Cr and V the $K\beta_{1,3}$ line was broadened on the high energy side, and the relative peak intensity of the low energy satellite $K\beta'$ was increased. In these additional contributions on both sides of the Cr $K\beta_{1,3}$ and V $K\beta_{1,3}$ lines, four components appeared, two on each side. The results are discussed in relation to some theoretical explanations of the origin of $K\beta'$. In the study of Dy $L\beta_{2,15}$ and its low-energy satellite $L\beta_{14}$ it was possible, after efforts to avoid contamination, to establish, on both sides of $L\beta_{2,15}$, additional contributions in the flash x-ray spectrum. (auth)

44430 PRECISION MEASUREMENTS OF L LEVELS IN THE ELEMENTS $_{35}Br$, $_{37}Rb$, $_{53}I$, $_{55}Cs$, AND $_{56}Ba$. Ingemar Andersson and Stig Hagstroem (Uppsala Univ.). Arkiv Fysik, 27: 161-71(1964).

The electron spectroscopic method was applied to the determinations of the L_I, L_{II}, and L_{III} levels in the elements bromine, rubidium, iodine, cesium, and barium, with the elements contained in chemical compounds. By combination of photoelectron data and x-ray-emission data, a table of electron binding energies was computed for the above elements. (auth)

44431 THE SADDLE POINT METHOD FOR MULTIPLE INTEGRALS, WITH AN APPLICATION TO THE EVALUATION OF RADIAL COULOMB MATRIX ELEMENTS FOR LARGE MULTIPOLE ORDERS. Bengt Nagel (Royal Inst. of Tech., Stockholm). Arkiv Fysik, 27: 181-92(1964).

The ordinary saddle point method for asymptotic evaluation of a one-dimensional integral containing a large parameter is extended to multiple integrals. The first two terms of the asymptotic expansion of the integral are given explicitly. The method is applied to the computation of radial Coulomb matrix elements for the K-shell photoeffect for large values of the angular momentum transferred from the photon to the photoelectron. Simple formulas are obtained, which can be used to complement the more complicated direct numerical calculations for the lower multipole orders. (auth)

44432 NEW DETERMINATION OF THE PHOTOIONIZATION AT THE PEAK OF AN INTENSE SHOCK WAVE. Carlo Ferrari and Joseph H. Clarke. Atti Accad. Nazl. Lincei. Rend., Classe Sci. Fis., Mat. Nat., (8) 35: 417-24 (Dec. 1963). (In Italian)

General equations are applied to the determination of the ionizing effect of peak radiation of a stationary, high-intensity shock wave. It is assumed that the gas is sufficiently rarefied at the wave front, and the degree of ionization is small enough, that recombination by collision can be neglected. The temperature of the radiations in this region is much greater than the temperature of the gas, and the degree of ionization $\alpha \ll 1$. (J.S.R.)

44433 EXPERIMENTAL STUDIES OF THE ANNIHILATION OF POSITRONS IN THE NOBLE GASES. W. R. Falk and G. Jones (Univ. of British Columbia, Vancouver). Can. J. Phys., 42: 1751-9(Sept. 1964).

The direct annihilation rate of positrons in He, Ar, and Kr was studied. Deviation from an exponential for the initial portion of the time distribution of these events is observed and is interpreted as a velocity dependence of the direct annihilation rate. The product of the gas pressure and the width of the nonexponential portion of the time distribution has a value of 270 nsec-atm and is approximately independent of the pressure. An estimate of the fraction of positrons forming positronium in Ar yields a value of 0.37 ± 0.03. Using this result, a check of the statistical ratio of ortho- to para-positronium formation indicates that

69 ± 7% of the positronium is formed in the ortho state. (auth)

44434 THE K-LL AUGER SPECTRUM OF $_{79}Au^{197}$. J. L. Wolfson and A. P. Baerg (National Research Council, Ottawa, Can.). Can. J. Phys., 42: 1781-92(Sept. 1964).

The K-LL Auger spectrum of ^{197}Au was examined using a high resolution beta spectrometer adjusted for a linewidth of 0.1% in momentum. A source of 65-hr ^{197}Hg was used. A six-line spectrum was observed, consisting of the lines $K-L_1L_1$, $K-L_1L_2$, $K-L_1L_3$, $K-L_2L_3$, and $K-L_3L_3$. The $K-L_1L_3$ line is noticeably wider than the others and may be interpreted as consisting of the two components $^3P_1$ and $^3P_2$. The energies of the lines are 51.78 ± 0.02, 52.42 ± 0.02, 54.20 ± 0.02, 52.95 ± 0.03, 54.81 ± 0.02, and 56.63 ± 0.02 kev respectively. The relative intensities found were, respectively, 1.00, 1.54 ± 0.11, 0.99 ± 0.09, 0.11 ± 0.03, 1.83 ± 0.13, and 0.75 ± 0.07. Neither the energies nor the intensities are in complete agreement with the latest theoretical work. (auth)

44435 AN ANALYSIS OF THE J-PHENOMENON IN X-RAYS. PART I. Hirendra Kumar Pal (Univ. of Calcutta). Indian J. Phys., 38: 61-78(Feb. 1964).

An attempt was made to study some aspects of the J-phenomenon in x rays from an analytical point of view. Some of the principal features of the phenomenon as well as the conditions governing the occurrence of the J-discontinuity in two kinds of experiments were discussed. It was shown from theoretical considerations that the effect, together with the associated features, is exactly what is expected under suitable circumstances. Barkla's concept of levels of x-ray activity was not considered in the analysis. (auth)

44436 COMPARATIVE ESTIMATION OF TWO SOLUTIONS FOR THE PROBLEM ON ELECTRON DISTRIBUTION IN A STATISTICAL ATOMIC MODEL. V. M. Klechkovskii (Academy of Agriculture, Moscow). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 4, 47-53(1964). (In Russian)

Correlations are made of two modifications for resolving the problem of atomic electron distribution based on the Thomas-Fermi model and using approximation expressions of Thomas-Fermi functions according to Tietz. It is shown that normalization to the complete number of electrons results in convergence of the two variations describing the functions between Z and electron distributions in the statistical neutral-atom model. (tr-auth)

44437 PROPAGATION OF SHORT ELECTROMAGNETIC IMPULSES IN ACTIVE MEDIUM. V. I. Talanov (Gor'kii Univ., USSR). Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 7: 491-6(1964). (In Russian)

Relations were obtained describing the concentration change of excited atoms and radiation density in a medium under the action of an incident impulse. (auth)

44438 MEASUREMENT OF THE EXCITATION CROSS SECTION OF N_2^+ FIRST NEGATIVE BAND BY ELECTRON IMPACT. S. Hayakawa and H. Nishimura (Nagoya Univ., Japan). J. Geomagnet. Geoelec., 16: 72-4(1964).

A photoelectric method with which the intensity and the decay rate of a line excited by a pulsed electron beam can be observed was developed. The excitation cross section of N_2^+ first negative band was measured. The result verifies the theoretical calculation by Nagata and Tohmatsu with which they analyzed the auroral phenomena at the south polar region. (C.E.S.)

44439 *ROTATIONAL MOTIONS IN HEXAMETHYLBENZENE AND AMMONIUM PERCHLORATE BY CROSS SECTION MEASUREMENTS WITH SLOW NEUTRONS.* J. J. Rush and T. I. Taylor (Columbia Univ., New York and Brookhaven National Lab., Upton, N. Y.). J. Phys. Chem., 68: 2534-7(Sept. 1964). (BNL-7908)

Neutron scattering cross sections for hexamethylbenzene and ammonium perchlorate were determined as a function of the neutron wave length and sample temperature. The slope $\Delta\sigma_s/\Delta\lambda_n$ of a plot of the scattering cross section per hydrogen atom vs the wave length of the neutrons (5 to 11.5 Å) was 9.5 ± 0.5 barns/Å-H atom for hexamethylbenzene at room temperature. From an empirical correlation of barriers to rotation vs $\Delta\sigma_s/\Delta\lambda_n$ for a series of ammonium salts and methyl-substituted compounds, this slope indicates an average barrier to rotation of methyl groups in hexamethylbenzene of approximately 1 kcal/mole. The slope for NH_4ClO_4 decreased from 13 barns/Å-H atom at 296°K to 2.5 barns/Å-H atom at 80°K. The magnitude of the scattering cross section and the slope indicates that the hindered rotational or torsional states of the ammonium ions are still significantly excited at 80°K. Cross section measurements on hexamethylbenzene as a function of temperature using neutrons with a wave length of about 10 Å show a small abrupt change at about 115°K, in the neighborhood of the λ-point transition. Analysis of the cross section curve in this region indicates that the change in cross section is due to a small change in barrier to rotation rather than to the onset of rotation of the methyl groups. This conclusion is consistent with the results of nuclear magnetic resonance measurements. (auth)

44440 FINITE BEAM CORRECTION FOR CIRCULAR SLIT GEOMETRY G-FACTOR. D. F. Herring and K. W. Jones (Ohio State Univ., Columbus). Nucl. Instr. Methods, 30: 88-92(Nov. 1964).

Charged particle detector systems commonly used in gas scattering experiments use a set of slits to define the length of target viewed by the detector. The "G-factor" for such systems depends upon the geometry of the slit system, as well as the size of the beam of bombarding particles. The dependence of the G-factor on the finite size of the bombarding beam is calculated for the case of circular front and rear defining slits. A formula for the G-factor is derived for the special case of a cylindrical beam of uniform density. (auth)

44441 MEASUREMENT OF THE INTERFERENCE IN THE SCATTERING OF SLOW ELECTRONS ON MERCURY ATOMS. J. Kessler and H. Lindner (Technische Hochschule, Karlsruhe). Phys. Letters, 11: 106-7(July 15, 1964). (In German)

Measurements of the effective cross sections for almost all energies between 200 and 4000 ev for which there are theoretical results were carried out for angles between 2 and 150°. The experimental set-up, which permitted continuous measurement of the angular distributions, is described. The theoretical and experimental results of the angular distribution of elastically scattered electrons were compared for electron energies of 300, 1200, and 2500 ev. The strong structure of the scattering cross sections originated from the interference of a finite number of partial waves of varying angular momenta. The good agreement between measured and theoretical values suggested that the large polarization effect predicted by theory actually occurred. (J.S.R.)

44442 TRANSITION RADIATION, BREMSSTRAHLUNG, AND PLASMA RAYS OF Ag TARGETS. P. von Blanckenhagen, H. Boersch, D. Fritsche, H. G. Seifert, and G. Sauerbrey (Technische Universität, Berlin). Phys. Letters, 11: 296-7(Aug. 15, 1964). (In German)

The radiation released by the electron irradiation of Ag

targets when the incident electrons are perpendicular to the target can be resolved into transition radiation and bremsstrahlung. The intensity of the transition radiation is directly proportional to the electron energy, and the bremsstrahlung is inversely proportional to the electron energy. When the electrons strike the target at an angle, the intensity of the radiation released is more than ten times the intensity of transition radiation and bremsstrahlung. The intensity is proportional to the electron energy. The site of the peaks indicates that this radiation is connected with surface excitation of the metal-electron plasma. (J.S.R.)

44443 BREMSSTRAHLUNG FROM ELECTRON-ION ENCOUNTERS IN A MAGNETIC FIELD. Robert Goldman (Princeton Univ., N. J.) and Ludwig Oster. Phys. Rev., 136: A602-5(Nov. 2, 1964).

The emission by a free electron undergoing Coulomb interactions in the presence of a strong external magnetic field has been computed, making use of the quantum-mechanical formalism for continuous radiation. The result holds for all frequencies except the ones at the cyclotron resonance proper. It is shown that the general results coincide with the known bremsstrahlung formula for frequencies much above the cyclotron resonance. (auth)

44444 PAIR CORRELATION FUNCTIONS OF A QUANTUM-MECHANICAL MANY-BODY SYSTEM WITH SEVERAL COMPONENTS. M. P. Kawatra (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 136: A610-17 (Nov. 2, 1964).

The three pair distribution functions have been calculated for a quantum-mechanical mixture of interacting gases obeying Bose-Einstein or Fermi-Dirac statistics in terms of the respective fugacity series expansions, the coefficients of which are temperature-dependent. The case of a mixture of two kinds of hard-sphere bosons has been explicitly studied and the results have been expressed up to first order in interaction parameters. (auth)

44445 QUANTUM STATISTICS OF THE DISTRIBUTION FUNCTIONS. A. Isihara and Daniel D. H. Yee (Polytechnic Inst. of Brooklyn). Phys. Rev., 136: A618-31 (Nov. 2, 1964).

A statistical-mechanical theory of evaluating the distribution functions of a many-body system is presented. The theory is a natural extension of the quantum statistical theory for the grand partition function. The density matrices are first developed in the Uhlenbeck–de Boer U functions. A diagrammatical consideration separates out nonconnected products from connected products of the U functions, yielding a simple expansion formula. Application of the resulting expression to free bosons and fermions is made. Then the distribution functions are developed in the binary kernel introduced by Yang and Lee. This expansion is used for the evaluation of the pair distribution function of a hard-sphere Bose gas at the lowest temperature. Use of the approximate pseudopotential $\phi = 8\pi a\delta(r_1 - r_2)$ is reflected in insufficiency of the chain diagram approximation. Satisfactory and consistent results are obtained when a new set of diagrams is taken into consideration. (auth)

44446 ERROR ESTIMATES IN THE VARIATIONAL MANY-BOSON CALCULATION. Richard J. Drachman (Goddard Space Flight Center, Greenbelt, Md.). Phys. Rev., 136: A641-2(Nov. 2, 1964).

A simple test is used to estimate the quality of a variational wave function in treating the ground state of the hard-sphere many-boson system. In this special case, the method can be simplified by using a result from the ground-state energy of the Bose gas. (auth)

44447 EXPERIMENTS ON RESONANCES IN THE ELASTIC CROSS SECTION OF ELECTRONS ON RARE-GAS ATOMS. G. J. Schulz (Westinghouse Electric Corp., Pittsburgh). Phys. Rev., 136: A650-6(Nov. 2, 1964).

Resonances in the elastic scattering are studied in a scattering experiment at an angle of 72° for He and Ne, and in a transmission experiment for He, Ne, Kr, and Xe. These resonances result from a compound state of the rare-gas atom and occur about 0.5 ev below the first excited state. The magnitude of the resonances can be enhanced in a transmission experiment when only the unscattered electrons are observed. It is pointed out that the resonance in helium can be used for a determination of the apparent electron energy distribution and as a calibration point on the electron energy scale. (auth)

44448 OPTICAL PUMPING IN He^3. R. C. Greenhow (Oxford Univ.). Phys. Rev., 136: A660-2(Nov. 2, 1964).

Nuclear polarization of ^3He has been performed using optical pumping techniques. The polarization is produced in the triplet metastable levels and transferred to the ground-state atoms by metastability exchange processes. The cross section for this process has been measured by two different methods, giving the results $\sigma = (6.1 \pm 1) \times 10^{-16}$ cm^2 and $\sigma = (7.9 \pm 2) \times 10^{-16}$ cm^2. One of the methods involved a spectroscopic determination of the density of metastable atoms in a weak discharge in ^3He, which was found to vary between 12.5 and 3.5×10^{10}/cc. It was shown that one hyperfine component only ($F = \frac{1}{2} \rightarrow \frac{3}{2}$) of the $2\,^3S_1 - 2\,^3P_0$ line of ^3He is excited by light from a ^4He lamp. For this reason a relation between the degree of polarization and the optical pumping signal needs to be modified. (auth)

44449 K-IONIZATION CROSS SECTIONS FOR RELATIVISTIC ELECTRONS. J. W. Motz and R. C. Placious (National Bureau of Standards, Washington, D. C.). Phys. Rev., 136: A662-5(Nov. 2, 1964).

Experimental values of the K-shell ionization cross section are determined from scintillation spectrometer measurements of the K x rays emitted when thin targets of tin and gold are bombarded by 50-, 100-, 200-, and 500-kev electrons. For these energies and atomic numbers, the experimental results show differences from the cross sections given by nonrelativistic and relativistic calculations, but show good agreement with predictions using relativistic free-particle wave functions for the projectile electron and nonrelativistic wave functions for the atomic electron. (auth)

44450 ABSORPTION AND BREMSSTRAHLUNG CROSS SECTIONS OF NITROGEN FOR SLOW ELECTRONS. R. V. DeVore (Ohio State Univ., Columbus). Phys. Rev., 136: A666-8(Nov. 2, 1964).

Cross sections are found for nitrogen and singly ionized nitrogen in their ground states. Results indicate that the screening of the nucleus has a negligible effect upon the nitrogen-ion cross sections. The inclusion of polarization and exchange forces in the analysis reduces the cross sections of the nitrogen atom by approximately an order of magnitude. (auth)

44451 SUM RULES FOR HYDROGENIC WAVE FUNCTIONS, WITH APPLICATIONS TO CHARGE-EXCHANGE AND IONIZATION PROCESSES. Robert M. May (Univ. of Sydney). Phys. Rev., 136: A669-74(Nov. 2, 1964).

Some general addition theorems are proven for certain matrix elements that involve hydrogen-atom wave functions. In particular, if $f_{nlm}(q)$ is the Fourier transform of the hydrogen-atom wave function with quantum numbers

n,l,m, then $|f_{nlm}(q)|^2$ summed over all l and m for a given n is equal to $2^6\pi a_0^{-5}n^{-3} \times (q^2 + a_0^{-2}n^{-2})^{-4}$, where a_0 is the Bohr radius. Two applications of the theorems are given. Firstly, charge-exchange reactions of the type $H^+ + H(n_1l_1m_1) \rightarrow H(n_2l_2m_2) + H^+$ are considered, and theorems of a general nature are used to obtain, for the cross section for reactions proceeding from the initial atomic state n_1 to the final state n_2, an expression both simple and fully exact (in Born approximation). Secondly, it is indicated how the theorems may be applied to get simple expressions for the cross sections for ionization of excited hydrogen atoms by various processes. (auth)

44452 MEASUREMENTS OF ELECTRON CAPTURE IN CLOSE H^+-ON-He AND He^+-ON-H COLLISIONS. Herbert F. Helbig and Edgar Everhart (Univ. of Connecticut, Storrs). Phys. Rev., 136: A674-9(Nov. 2, 1964).

Differential measurements of electron capture probability P_0 are made for close encounters in the reaction $H^+ + He \rightarrow H + He^+$. The energy range of the incident proton is 1.6 to 180.0 kev and the scattering angle is 0.5 to 4°. The impact parameters associated with these collisions extend from 0.015 to about 0.50 Å. There is little angular dependence to the data. When P_0 is plotted versus energy, a damped resonant structure is seen with peaks at 36, 7, and 2.6 kev with relative amplitudes of 0.52, 0.16, and 0.05 respectively. The phenomena are discussed in terms of the energy-level diagram for $He-H^+$ and with reference to the existing theories for charge transfer in the nonresonant case. Measurements of the inverse reaction, He^+ ions incident on atomic hydrogen targets, are also presented and discussed. (auth)

44453 FINITE-MASS HELIUM ATOMS. I. THE $2\,^1P$ STATE. Milos Machacek, Frank C. Sanders, and Charles W. Scherr (Univ. of Texas, Austin). Phys. Rev., 136: A680-3(Nov. 2, 1964).

The $2\,^1P$ states of the helium isoelectronic series are investigated via 50-term variational wave functions containing two nonlinear parameters. The Hamiltonian, spin-free and nonrelativistic, is written directly in center-of-mass coordinates so that no adiabatic approximation is required. The expectation values of the Hamiltonian and of moments of the interparticle separations are reported. Isotope shifts agree with experiment. In order to compare the results with theoretical results, the systems were similarly studied in the infinite-nuclear-mass limit (adiabatic approximation). The energies so obtained are the deepest thus far obtained by a direct calculation with a variational wave function. The expectation values of the operators were subjected to a differencing process to obtain estimates of the perturbation expansion coefficients for them, and the results are in agreement with the directly calculated results. (auth)

44454 PROPOSAL FOR MEASURING LAMB SHIFTS BY THE STUDY OF MODULATED, FLUORESCENT LIGHT. G. W. Series (Oxford Univ.). Phys. Rev., 136: A684-8 (Nov. 2, 1964).

A method is proposed for measuring the interval between two atomic energy levels of different parity. The method is related to optical radio-frequency double resonance and level-crossing experiments in that the behavior of atoms in excited states is deduced from observations of the fluorescent light. In contrast with the oscillating electric field ordinarily used to stimulate transitions between states of opposite parity, a small, static electric field is required. The rate at which atoms are excited is required to be modulated; consequently, the fluorescent light will be modulated. The amplitude of modulation will depend on the parameters. A general expression is derived. Two cases are of particular interest: a resonance effect is predicted if the frequency of modulation matches the interval between the perturbed levels (this effect could best be studied for frequencies much greater than the combined natural widths of the levels); and for frequencies smaller than the natural width, a level-crossing effect is predicted whose peak occurs at the point of intersection of the unperturbed levels. The method might be applied to measure intervals between the 2s and 2p levels in hydrogen. Estimates are given of the required fields and frequencies. (auth)

44455 FAR-INFRARED ELECTRONIC TRANSITIONS IN IONS AND PAIRS OF IONS. Armand Hadni (Université, Nancy). Phys. Rev., 136: A758-61(Nov. 2, 1964).

In ruby (1% Cr_2O_3), two dichroic lines are found at 100 and 270μ; in pure praseodymium chloride, two dichroic lines at 100 and 325 μ; and in diluted samarium chloride (5% Sa^{3+} in $LaCl_3$), two lines at 100 and 250 μ. A tentative explanation is given for all these lines as transitions between sublevels of the ground-state split either by the crystalline field or by exchange forces between neighboring ions. (auth)

44456 GROUP-THEORETICAL CONSIDERATION OF LANDAU LEVEL BROADENING IN CRYSTALS. J. Zak (Massachusetts Inst. of Tech., Cambridge). Phys. Rev., 136: A776-80(Nov. 2, 1964).

A group-theoretical classification of the energy levels for a Bloch electron in a magnetic field is given. The fact is used that the magnetic translation group is a subgroup of the symmetry group for a free electron in a magnetic field, and it is shown that the broadening of the Landau levels in crystals is a general feature that follows from symmetry considerations. An explicit formula for the broadening in the case of cubic symmetry has been derived. (auth)

44457 PENETRATION OF HEAVY IONS OF kev ENERGIES INTO MONOCRYSTALLINE TUNGSTEN. E. V. Kornelsen (National Research Council, Ottawa), F. Brown, J. A. Davies, B. Domeij, and G. R. Piercy. Phys. Rev., 136: A849-58(Nov. 2, 1964).

The penetration of radioactive alkali metal (^{24}Na) and inert gas (^{41}Ar, ^{85}Kr, ^{125}Xe, and ^{133}Xe) ions into oriented monocrystals of tungsten has been measured in the energy range 0.25 to 160 kev using an electrochemical stripping technique. For energies ≤20 kev, the ion bombardments were performed in ultrahigh vacuum with the crystal surfaces free of oxides and adsorbed gases. The resulting integral penetration distributions clearly confirm the theoretically predicted channeling of the incident ions along the more open directions in the crystal lattice. Maximum channel penetrations (in the ⟨111⟩ and ⟨100⟩ directions) were observed to be about one order of magnitude larger than those measured for "amorphous tungsten." Extremely penetrating "tails" on the penetration distributions have also been observed, extending to >5 mg/cm^2 as compared to median penetrations of 0.01 to 0.2 mg/cm^2. These may be associated with excitation of the channeled atoms through multiple collisions, but definite confirmation of this mechanism has not yet been obtained. (auth)

44458 RESONANCES IN THE INELASTIC CROSS SECTION OF HELIUM. G. J. Schulz and J. W. Philbrick (Westinghouse Research Labs., Pittsburgh). Phys. Rev. Letters, 13: 477-8(Oct. 12, 1964).

The cross section for electron inelastic scattering at 72° to the $2\,^3S$ state of helium was measured as a function of electron energy. Structure was observed around 21 and 22.4 ev, which was attributed to compound states above the lowest excited state. (D.C.W.)

44459 OBSERVATION OF AUTOIONIZATION LEVELS IN He BY POSITIVE ION BOMBARDMENT. M. Eugene Rudd (Concordia Coll., Moorhead, Minn.). Phys. Rev. Letters, 13: 503-5(Oct. 19, 1964).

Autoionization levels in helium were observed by measuring the energy spectrum of electrons emitted after bombardment with protons and molecular hydrogen ions. (D.C.W.)

44460 RESONANCES AND LONG-RANGE EFFECTS. A. Herzenberg, K. L. Kwok, and F. Mandl (Univ. of Manchester, Eng.). Proc. Phys. Soc. (London), 84: 345-50 (Sept. 1964).

A perturbation theory is developed to allow for long-range interactions in the Kapur–Peierls resonance scattering theory. Applied to the electron-atomic hydrogen system, it is found that the position and width of the narrow 9.61-ev ^1S level are changed by only a few per cent, the position of the level being depressed. (auth)

44461 PERTURBATION METHODS IN THE DYNAMICS OF CONTINUOUS MEDIA. F. Gascón (Universidad, Barcelona). Proc. Phys. Soc. (London), 84: 351-6(Sept. 1964).

After introducing the hamiltonian representation for continuous systems, a technique is presented for calculating the evolutions of continuous systems submitted to any fields, starting from the solutions for simple motions. (auth)

44462 RATIONAL APPROXIMATIONS TO THE ORDINARY THOMAS-FERMI FUNCTION AND ITS DERIVATIVE. J. C. Mason (Oxford Univ.). Proc. Phys. Soc. (London), 84: 357-9(Sept. 1964).

Approximations to the function and its derivative over the range $(0, \infty)$ are obtained, having absolute errors less than 0.000 012 and involving just six coefficients. (auth)

44463 RELATIVISTIC EFFECTS IN CHARGE TRANSFER. M. H. Mittleman (Univ. of California, Livermore). Proc. Phys. Soc. (London), 84: 453-4(Sept. 1964). (UCRL-7900-T(Rev.))

The relativistic corrections to charge exchange by protons on hydrogen are calculated. It is found that relativistic effects completely change the high-energy behavior, but that the corrections are insignificant at the highest energies yet used (10 Mev). (D.C.W.)

44464 CORRELATIONS OF ELECTRONS IN SMALL MOLECULES. A. Herzenberg (Univ. of Manchester, Eng.), D. Sherrington, and M. Sueveges. Proc. Phys. Soc. (London), 84: 465-76(Oct. 1964).

Recent advances in the theory of the giant dipole resonance in nuclei suggest that systems of a small number of fermions interacting through a repulsive residual force should have collective states. The theory is adapted to small molecules and is applied to ethylene with the Coulomb potential replaced by a dipole–dipole interaction. This approximation should reproduce effects due to correlations arising from the long range of the Coulomb potential. The excitation energies of "single-particle–single-hole" triplet states are taken either from experiment or from rough non-empirical values available in the literature. The calculation yields a collective singlet state at about 50 ev, in a region which has not yet been explored experimentally. It suggests also that long-range correlations lead to reductions by about a factor 2 in the spacing of the lowest singlet and triplet excited states (as compared with the value for a pure $\pi \rightarrow \pi^*$ excitation) and for the dipole transition moment from the lowest excited singlet to the ground state. These results arise from cooperative interactions of several electrons. The reduction of the strength of the π-π interaction can be expressed as a dielectric effect due to the other electrons. (auth)

44465 THE Z-EXPANSION OF UNRESTRICTED HARTREE-FOCK ATOMIC ORBITALS. C. A. Coulson (Oxford Univ.). Proc. Phys. Soc. (London), 84: 511-16 (Oct. 1964).

It is shown that in the open-shell (unrestricted) Hartree-Fock wave function for the ground state ^1S of helium-like atoms, the two orbitals u and v have terms in $Z^{-\frac{1}{6}}$, $Z^{-\frac{1}{3}}$, ... as well as Z^{-1}, Z^{-2}, ..., when expanded in a perturbation series in powers of Z^{-1}. But standard perturbation theory methods are not able to fix the orbitals uniquely. Consideration of the appropriate Hartree-Fock equations for u and v show that, in terms of Z, $u(r,Z^{\frac{1}{3}}) = v(r,-Z^{\frac{1}{3}})$. If u is expanded as $u(r,Z) = u_0(r) + Z^{-\frac{1}{3}}u_{\frac{1}{3}}(r) + Z^{-1}u_1(r) + \ldots$ an approximate expression for $u_{\frac{1}{3}}$ is $\{(2Zr + 3)/4\sqrt{2}\}u_0$. (auth)

44466 INELASTIC ATOMIC COLLISIONS INVOLVING THE PSEUDO-CROSSING OF POTENTIAL ENERGY SURFACES. D. R. Bates, H. C. Johnson, and I. Stewart (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 84: 517-25(Oct. 1964).

The coupled equations of the semi-classical, two-state approximation (with velocity of relative motion treated as constant) are considered. It is shown that the probability of a transition occurring for given impact parameter may be expressed in terms of the solutions to these equations at the point where the colliding atoms are closest. The formula obtained is rather similar to, but has revealing differences from, the corresponding formula of the Landau-Zener approximation. The significance of the differences is discussed. Detailed calculations are carried out on $H + Be^{2+} \rightarrow H^+ + Be^+$ and on $H + Mg^{2+} \rightarrow H^+ + Mg^+$. The cross section–energy curve for the first has a single peak, the magnitude of which is almost twice that given by the Landau-Zener approximation; that for the second has two widely separated peaks. (auth)

44467 MOLECULAR REARRANGEMENT COLLISIONS AT HIGH IMPACT ENERGIES. J. C. Light and J. Horrocks (Univ. of Chicago). Proc. Phys. Soc. (London), 84: 527-30 (Oct. 1964).

The cross section for the rearrangement reaction between a bound pair (2,3) and a third body 1 is calculated on the assumption of a single hard-core collision between bodies 1 and 2. Geometrical and dynamical restrictions on the cross section are shown to be insensitive to the impact energy E_{12} so that the effective cross section varies approximately as E_{12}^{-1}, vanishing when $E_{12} = D[m_0m_2(m_1 + m_3)/m_3(m_1 - m_2)^2]$ and therefore remaining important at high energies provided $m_1 \simeq m_2$. (auth)

44468 A REMEASUREMENT OF THE 2^3S EXCITATION CROSS SECTION IN HELIUM. R. J. Fleming and G. S. Higginson (Queen's Univ., Belfast). Proc. Phys. Soc. (London), 84: 531-8(Oct. 1964).

The classical experiment of Maier-Leibnitz was repeated. Corrections were applied for secondary electron emission from mesh and collector electrodes resulting from the incidence of metastable helium atoms, for the finite permeability of the mesh to electrons and for the value of retarding potential between mesh and collector. Random walk calculations were used to determine the mean number of elastic collisions made by an electron in traversing the apparatus. The value obtained at the maximum of the 2^3S cross section is 2.6×10^{-18} cm^2 ± 17%, indicating that the error in the original determination (3.7×10^{-18} cm^2 ± 20%) was underestimated. (auth)

44469 DIRECT MEASUREMENTS OF THE LIFETIMES OF EXCITED STATES OF NEUTRAL HELIUM. R. G. Fowler, T. M. Holzberlein, C. H. Jacobson, and S. J. B. Corrigan (Univ. of Oklahoma, Norman). Proc. Phys. Soc. (London), 84: 539-43(Oct. 1964).

The lifetimes of six states in helium were measured by direct decay observations. The results are in rather good agreement with theory. Additional information on the contribution of indirect population processes was also obtained. (D.C.W.)

44470 IONIZATION AND DIFFUSION BY ELECTRONS IN HYDROGEN IN MIXED OSCILLATORY AND UNIDIRECTIONAL FIELDS. W. A. Prowse and J. M. Nicholls (Univ. of Durham, Eng.). Proc. Phys. Soc. (London), 84: 545-55 (Oct. 1964).

The growth of ionization by collision resulting from the application of an oscillatory electric field E_u(100 Mc/s) to hydrogen in the pressure range 3 to 10 mm Hg was studied. Hollow parallel-plate electrodes of Rogowski profile were used, one perforated so that initial electrons from a thermionic source were admitted into the gap. An oscillating ellipsoid field-meter was used to measure the oscillatory field intensity and calibrate indicating meters. A unidirectional field much smaller than the oscillatory field was used to sweep electrons and ions to the electrodes. The chief quantity measured was the electron current $\underline{i}$ to the anode, examined as a function of E_u. Writing i_0 for the value when E_u is zero, the gas amplification A is i/i_0. It was found that, as E_u increases from zero, A first decreases and then increases, tending towards a very large value at the threshold of breakdown. The initial decrease is interpreted in terms of back diffusion of the electrons, and the later increase is attributed to collision ionization. Methods of assessing the electron lifetime t_1 are considered; from A and t_1 it is possible to derive values of an ionization coefficient which agree fairly closely with values from Townsend's method. (auth)

44471 THE VELOCITY-DEPENDENT ANNIHILATION RATE OF SLOW POSITRONS IN ARGON. D. A. L. Paul (Univ. of Toronto). Proc. Phys. Soc. (London), 84: 563-72(Oct. 1964).

The time spectra of positrons annihilating in pure Ar gas were found to be characterized by a pronounced shoulder. The shoulder is associated with a velocity-dependent annihilation rate of positrons which are slowing down within the range 9 to 0 ev. The annihilation rate of positrons was derived as a function of time, and an attempt was made to convert the results to a function of velocity by establishing a velocity-time density matrix. Corresponding theoretical values of the annihilation rates for Ar were calculated from previously published wave functions over the range from 0.68 to 6.8 ev. The theoretical values are three times the experimental values at the higher energies in this range. The need to use polarized atomic wave functions for positron scattering and annihilation calculations is clearly indicated. Below 1 ev there is a marked increase in the observed annihilation rate, which is in no way indicated by the theoretical results; this increase could arise from the formation of an Ar-positron ion at low positron velocities. (auth)

44472 RELATIVE SECONDARY ELECTRON COEFFICIENTS FOR 40-kev NOBLE GAS AND ALKALI METAL IONS ON ALUMINUM. N. R. Daly and R. E. Powell (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Proc. Phys. Soc. (London), 84: 595-8(Oct. 1964).

The relative secondary electron coefficient γ of 40- and 80-kev singly and doubly charged gas ions was measured by a new method. Values of γ were also obtained for singly charged ions of the alkali metals. The results were compared with those obtained previously. The applicability of the Ploch correction factor to ion current measurements using a scintillation detector was considered. (auth)

44473 THRESHOLD ELECTRICAL FIELD FOR DISSOCIATION OF THE H_2^+ ION. H. Wind (Culham Lab., Abingdon, Berks, Eng.). Proc. Phys. Soc. (London), 84: 617-19(Oct. 1964).

The dissociation by an electrical field of H_2^+ ions formed by the breakup of H_3^+ ions was studied. It was found that a minimum field of $0.96 \pm 0.05 \times 10^4$ v cm^{-1} is required to produce dissociation. This is consistent with an available theoretical value of 10^4 vcm^{-1} which is, however, uncertain to within a factor of 2. (auth)

44474 ELASTIC SCATTERING OF SLOW ELECTRONS BY CARBON: THE CONTRIBUTION OF DOUBLET SPIN STATES. M. R. C. McDowell (Univ. of Durham, Eng.) and V. P. Myerscough. Proc. Phys. Soc. (London), 84: 622-3 (Oct. 1964).

Static central field exchange approximation phase shifts for the $[(2p)^2\ ^3P]k^20\ ^2P$ channel at impact energies $k^2 \leq 0.1$ ryd are reported and are used with previous results for the $k^20\ ^4P$ channel to obtain the partial cross section $Q_0(k^2)$. (auth)

44475 THE METHOD OF POLARIZED ORBITALS FOR THE ELASTIC SCATTERING OF SLOW ELECTRONS BY IONIZED HELIUM AND ATOMIC HYDROGEN. I. H. Sloan (University Coll., London). Proc. Roy Soc. (London), Ser. A, 281: 151-63(Sept. 8, 1964).

The method of polarized orbitals is analyzed for scattering by hydrogen or ionized helium, and is shown to require modification for p-wave scattering; with this change the polarized-orbital phase shifts for all angular momenta are associated with a variational principle. As the additional terms in the p-wave equation involve the first derivative, a novel numerical method (similar to Numerov's method) was devised for the convenient and rapid solution of linear second-order differential equations containing the first derivative, and extended to the integro-differential equations arising in the non-iterative solution of the problem. Polarized-orbital phase shifts are presented for the singlet and triplet scattering by ionized helium of s-, p-, and d-wave electrons, at energies up to the ionization threshold. At low energies these agree closely with the predictions of the quantum-defect method, provided that the modified equation is used for p-wave scattering. Electron-hydrogen p-wave phase shifts were also obtained with this equation; the new phase shifts increase slightly (≤5%) the total cross sections calculated by Temkin & Lamkin. The simpler exchange polarization approximation yields phase shifts in quite good accord with those of the (modified) method of polarized orbitals. (auth)

44476 MEASUREMENT OF PENETRATION DEPTH OF ELECTRONS AND IONS IN THIN EVAPORATED LAYERS. L. Morbitzer and A. Scharmann (Universitat, Giessen, Ger.). Z. Physik, 181: 67-86(1964). (In German)

The penetration depth of electrons, H^+-, He^+-, Ne^+-, and Ar^+-ions in thin evaporated layers of alkali fluorides and alkaline earth fluorides were investigated by measuring the excitation and deterioration of the luminescence caused by the bombardment with electrons and ions. Particle energy ranged up to 10 kev for electrons and the lighter ions and up to 30 kev for the heavier ions; film thicknesses were chosen between 5 and 100 μg/cm^2. The penetration depths defined by the two different techniques are called maximum excitation depth and maximum deterioration depth.

By measuring the excitation depth a depth distribution may be obtained. Using the Bethe-equation a numerical penetration depth-energy-relation for electrons was derived which gives good agreement with the experimental values. The results of the deterioration depths of the ions are compared with the theoretical predictions of Lindhard and Scharff. (auth)

44477 THE VAVILOV-CHERENKOV EFFECT IN MAGNETIZED FERRITE. E. D. Gazazyan and O. S. Mergelyan. Zh. Tekhn. Fiz., 34: 1432-5(Aug. 1964). (In Russian)

Equations were obtained for the fields, energy losses, and polarization of Vavilov-Cherenkov radiation in magnetized ferrite. The problem was resolved under the assumption that the gyration parameter is small in comparison to the ferrite magnetic penetrability. (R.V.J.)

44478 EFFECT OF IMPURITIES ON THE NONEQUILIBRIUM DISSOCIATION OF A DIATOMIC GAS BEHIND A SHOCK WAVE. Yu. P. Lun'kin and F. D. Popov (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 34: 1526-30(Aug. 1964). (In Russian)

The sharp increase in temperature that disturbs the energy balance during gas dissociation by a shock wave was studied using mixtures of mono- and diatomic gases and two diatomic gases. (R.V.J.)

44479 THEORY OF INELASTIC SCATTERING. A. J. Glick (Univ. of Maryland, College Park). 30p. (CONF-753-1)

From Symposium on Quantitative Electron Microscopy Held at Armed Forces Inst. of Pathology, Washington, D. C., Mar.-Apr. 1964.

Theory for electron inelastic scattering and for the effects of the microscopic properties of the scattering medium on the scattering is reviewed. The scattering is formulated in terms of the frequency- and wave number-dependent dielectric constant of the medium. The feasibility of determining the electron excitation spectrum of the target material from observed cross sections is also considered. (D.C.W.)

Cosmic Radiation

Refer also to abstracts 43835 and 44396.

44480 (AFCRL-64-403) GEOPHYSICAL ASPECTS OF COSMIC RAYS. Final Report. Arne Eld Sandstroem (Uppsala Univ. Inst. of Physics). Apr. 27, 1964. 26p. (AD-600894)

The research program is described. In addition diagrams are reproduced concerning the phase shifts of the yearly mean diurnal variation. Histograms are presented that demonstrate the main types of cosmic-ray storms as recorded at stations above the latitude knee of the nucleon component. Three sections concern the modulation during CRS. Results are given concerning the yearly mean direction of the cosmic ray anisotropy. (auth)

44481 (EFINS-63-68) COSMIC RADIATION. Peter Meyer (Chicago. Univ. Enrico Fermi Inst. for Nuclear Studies). [1963]. 32p. (NASA-CR-55438; N64-14868; CONF-737-1)

From IGY/IGC Symposium, University of California, Los Angeles, Aug. 1963.

Some solar physical phenomena associated with variations in the intensity of galactic cosmic particles entering the inner solar system are discussed. (R.E.U.)

44482 SPECIFIC SOLAR FLARE EVENTS AND ASSOCIATED RADIATION DOSES. T. Foelsche (Langley Research Center, Hampton, Va.). Am. Soc. Testing Mater., Spec. Tech. Publ., 363(1963), 1-13(1964).

Solar proton spectra and their time variations are discussed, and doses on the surfaces of bodies or behind different amounts of shielding over long periods of solar activity are indicated. The more recently observed low-energy parts of the spectra are also discussed; effects on materials are summarized, together with associated threshold doses. (D.C.W.)

44483 THE USE OF THE MEAN BLOB LENGTH METHOD FOR THE IDENTIFICATION OF HEAVY PRIMARIES IN COSMIC RADIATION. Anders Stenman (Univ. of Lund, Sweden). Arkiv Fysik, 27: 267-74(1964).

A study is made of the blob length method as a means of identifying relativistic heavy primaries in cosmic radiation. The measurements were restricted to particles with well identified charges $Z \geq 6$. The standard deviation was found to be 1.0 unit of charge in the mean. The experimentally obtained relation between the blob coefficient and the square of the particle charge is given and discussed. The blob coefficient was also studied as a function of the dip angle. (auth)

44484 AN APPARENT ANOMALY OF THE BAROMETRIC COEFFICIENT FOR THE NUCLEONIC COMPONENT OF COSMIC-RAY INTENSITY. S. M. Lapointe (Univ. of Montreal). Can. J. Phys., 42: 1847-56(Oct. 1964).

A statistical analysis, based on three and one-half years of observational data, previously published by Lapointe and Rose, produced a larger barometric coefficient for the nucleonic intensity in the standard neutron monitor at Sulphur Mountain (altitude 2283 meters) than at Ottawa (same geomagnetic latitude, sea level station). To explain this apparent anomaly, a simple theoretical model is presented which reproduces the results of this statistical analysis. The model treats the nucleonic component as consisting of two distinct cascades of nucleons, one "hard," characterized by a greater attenuation length and smaller pressure coefficient, and one "soft," characterized by a shorter attenuation length and larger pressure coefficient. The validity of the model is discussed. (auth)

44485 PROTONS IN THE INNER RADIATION BELT. Gerhard Haerendel (Max-Planck-Institut für Physik und Astrophysik, Garching, Ger.). Fortschr. Physik, 12: 271-346(1964). (In German)

The proton distribution at the lower limits of the radiation belt was numerically calculated as an equilibrium between a supplement from the decay of the albedo neutrons of cosmic radiation and losses by collisions in the upper atmosphere. By approximation to the mean of the atmospheric density over the particle motion, calculations of the particle orbits in the earth's magnetic field were drawn upon. With a model and an atmospheric density pattern as derived from the orbit variations of artificial satellites, the observed proton distribution over 30 Mev up to a flux density of 10^3 cm^{-2} sec^{-1} could be well represented. However, a neutron current over 30 Mev is stronger by a factor of 7 than was found theoretically. At higher values of the flux density the comparison with observation is forced to introduction of losses on the basis of the finite length of the confinement in the earth's magnetic field. It was plausible that a violation of the adiabatic invariants connected with the longitudinal drift by hydromagnetic waves was responsible. The theoretically derived time scale of these processes and their energy and site dependence corresponded to the requirements of the observations. An interpretation of the minima at 2 earth radii distance and the time variations was given on this basis. (tr-auth)

44486 PHYSICAL CONDITIONS IN THE VICINITY OF THE SOLAR SYSTEM ACCORDING TO MEASUREMENTS OF POLARIZATION OF COSMIC RADIATION. V. A. Razin (Gor'kii Univ., USSR). Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 7: 395-8(1964). (In Russian)

The polarization of cosmic radiation was measured. The polarization is caused by the Faraday effect and should give an indication of the physical conditions existing in interplanetary and interstellar space. (C.E.S.)

44487 THE EFFECTIVE TEMPERATURE OF THE LUNAR SURFACE DUE TO REFLECTION OF COSMIC RADIATION. A. M. Starodoubtsev (Gor'kii Univ., USSR). Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 7: 399-405 (1964). (In Russian)

The effective temperature of the lunar surface due to reflection of cosmic radiation at the frequencies 100, 200, and 400 Mc is calculated. As the model of the moon a dielectric sphere was considered with perfectly smooth surface, the permittivity being equal to 1.5–4. From calculations, it follows that the average brightness temperature changes weakly as a function of the moon elevation angle and only in the angle region $\alpha = 280°$ an increase in temperature takes place and the polarization ratio of radiation reflected from the lunar surface weakly depends on frequency and for $\epsilon = 1.5$ does not exceed 12%, the averaged value being about 2 to 5%. (auth)

44488 A 27-DAY RECURRENCE TENDENCY IN COSMIC RAY INTENSITY AND ITS CORRELATION WITH SOLAR AND GEOMAGNETIC ACTIVITY. Satoru Mori (Nagoya Univ., Japan), Hirosachi Ueno, Kazuo Nagashima, and Syuji Sagisaka. J. Geomagnet. Geoelec., 16: 68-71 (1964).

A typical 27-day recurrence tendency in cosmic ray intensity was found which continued through 18 solar rotations. This variation is reported in connection with solar and terrestrial phenomena. (C.E.S.)

44489 ACCELERATION BY RADIATION AND THE GENERATION OF FAST PARTICLES IN OUTER SPACE. II. ON SUPERNOVA OUTBURSTS. V. N. Tsytovich (Lebedev Inst. of Physics, Moscow). Soviet Astron.-AJ (English Transl.), 8: 4-12(July-Aug. 1964). Translated from Astron. Zh., 41: 7-18(Jan.-Feb. 1964).

The question of the role of acceleration brought about by radiation in the outbursts of supernovas is analyzed. It is noted that the envisaged acceleration mechanism may in any case function as an efficient injector. Given the most optimistic estimates, the radiation is at present capable of accelerating electrons of the Crab Nebula to maximum observed energies. The interpretation attempted removes some of the difficulties encountered in earlier concepts. The mechanism under consideration accounts for the acceleration of electrons and heavy ions predominantly. (auth)

Criticality Studies

44490 APPLICATION OF A SIMPLE, PRACTICAL METHOD FOR COMPUTING INTERACTION TO ARRAYS FOUND EXPERIMENTALLY TO BE CRITICAL. Hugh K. Clark (E. I. Du Pont de Nemours & Co., Aiken, S. C.). Nucl. Sci. Eng., 20: 307-13(Nov. 1964). (TID-20533)

Calculations of the critical sizes of cubic arrays of interacting fissionable units are compared with critical experiments. The units are of two types: vessels containing 5 liters of an aqueous solution of highly enriched uranium, and cylinders of highly enriched uranium metal. The arrays are surrounded by various thicknesses of hydrogenous reflectors. Agreement between calculation and experiment is reasonably good. Tables are presented for computing critical and safe sizes of cubic arrays of 8, 27, 64, or 125 identical units as a function of the albedo of the reflector surrounding the array and of the reactivity of an individual unit. (auth)

Direct Energy Conversion

Refer also to abstracts 45044 and 45080.

44491 (AD-601111) RESEARCH STUDIES ON THERMIONIC CONVERTERS, EMITTER SHELL PHASE. Report No. 3. Third Quarterly Technical Report, January 1–March 31, 1964. M. N. Slater (Radio Corp. of America. Special Electronic Components Div., Lancaster, Penna.). Apr. 1964. Contract DA-36-039-AMC-03197(E). 34p.

Effort was directed toward completion of the permeation studies of sample materials, development of alternate barrier designs, and fabrication of converters for evaluation and life testing. The permeation of fossil fuel combustion gas was determined for alumina, beryllia, and silicon carbide samples, using a prototype burner designed for this purpose. Supplemental tests were run using helium, argon, and nitrogen on alumina and hydrogen on silicon carbide. Alumina appeared to be the best barrier material of those tested. Alternate barrier-emitter systems were designed, including multilayer-coated molybdenum cups and a double-walled alumina-molybdenum assembly with helium-filled interstice. A double-walled converter over eight watts on preliminary test. (auth)

44492 (AFCRL-64-12) PLASMA PROPERTIES IN A THERMIONIC CONVERTER. Final Report. R. H. Bullis and W. J. Wiegand (United Aircraft Corp. Research Labs., East Hartford, Conn.). Dec. 31, 1963. Contract AF19 (604)-7494. 10p. (AD-600096; AFOSR-64-0898; CONF-740-1)

From 24th Annual Conference on Physical Electronics, Massachusetts Inst. of Tech., Mar. 1964.

The properties of the non-equilibrium plasma existing in the interelectrode space of the arc-mode converter were investigated with coaxial electrostatic Langmuir probes. Probe measurements were made as a function of cesium pressure, emitter temperature, interelectrode position, and converter out-put in several low-temperature arc-mode converters. The plasma potential was found to vary significantly across the interelectrode space. Both the existence of a retarding sheath for electrons very close to the emitter surface and a region farther from the emitter in which the variation in plasma potential is accelerating for electrons were detected. Significant variations in the plasma potential existing in the space were observed with changes in emitter temperature, cesium pressure, and converter output. The electron energy distribution is non-Maxwellian with a significant number of electrons with energies in excess of 1.4 ev. However, from an analysis of the production and loss rates in the converter, there is an insufficient number of electrons, even in the accelerated electron energy distribution, to account for the enhanced degree of ionization observed in arc-mode operation by single-stage electron-atom collisional ionization processes. Further analyses of the production and loss rates using the electron energy distribution indicate that ambipolar diffusion is the dominant loss process in the converter if the major ionic species is Cs^+. However, if the major ionic species in the converter is Cs_2^+, then recombination is the dominant loss mechanism. (auth)

44493 (ANL-6800(p.403-23)) ENERGY CONVERSION. (Argonne National Lab., Ill.).

Work on the development of methods for the conversion of heat into electrical energy was continued. The major effort was devoted to thermally regenerative emf cells. Work on the thermocouple effect was limited to experiments needed for the rounding out of the thermoelectricity program, which is being terminated. Thermodynamic analysis of the emf-temperature-composition data for the Li–Bi system was completed. Emf-temperature-composition data on the Li–Sn system have also been obtained. Compositions from 0.10 to 0.50 atom fraction of Li in Sn at 760 to 1120°K were studied. A thermodynamic analysis of the data is in progress. Solid-liquid equilibrium data for the binary salt system LiH–LiBr were analyzed and about 400 cal/mole positive excess chemical potentials were found for LiH. A study was made of the heat of fusion of LiH, since this value is the least accurately known parameter needed for calculations of thermodynamic functions in the LiH–LiCl and LiH–LiBr systems. The results of this study were in close agreement with a literature-based value of 5240 cal/mole for the heat of fusion of LiH and indicated that earlier values of about 7000 cal/mole are in error. Regeneration of the binary metal alloy systems, Li–Bi, Li–Sn, and Na–Sn, was demonstrated. Detailed mass spectrographic studies of the Li–Bi system were made; Li^+ and Bi^+ were the predominant vapor species. A value of –46.0 kcal/mole was calculated for the free energy of formation of Li_3Bi. This value is in good agreement with the value of –43.2 kcal/mole obtained in bimetallic cell studies. However, the vapor pressure of the Li is relatively low while the Bi vapor pressure increases rapidly at temperatures above 900°C, thereby making good separations of Li from Bi difficult. Separations of Li from Sn and Na from Sn were demonstrated with 50 at. % alloys sealed under vacuum in long stainless steel tubes. 90% of the total Na and 16.7% of the total Li distilled from their respective alloys when the alloys were heated at 950°C and the alkali metals condensed at 450°C. Although cell performance and regeneration of Sn binary systems appear to be favorable, corrosion problems due to Sn may be difficult to solve, especially at high regenerative temperatures. A Na–Bi bimetallic cell appears to be the system best suited for initial engineering studies since adequate corrosion data on both Na and Bi metals are available. Studies of this system are in progress. Electrical resistivity measurements for a series of US–ThS solid solutions of varying composition ratios show only a very slight dependence on temperature at 0 to 1100°C A maximum in the resistivity occurs at a mole ratio of US to ThS of about 75/25. Figure of merit values were calculated using the resistivity data, previous Seebeck coefficient data, and thermal conductivity data. The figure of merit values do not change appreciably with temperature. However, they are too low by approximately a factor of 10 for useful high temperature thermoelectric power generation. (auth)

44494 (ARL-64-61) ELECTRO-FLUID DYNAMIC ENERGY CONVERSION PROCESSES FOR POWER GENERATION. S. Hasinger, M. Hawes, M. O. Lawson, H. J. P. von Ohain, and F. L. Wattendorf (Aerospace Research Labs., Wright-Patterson AFB, Ohio). [1964]. 40p. (CONF-663-1; AD-434089)

From 6th Agard Combustion and Propulsion Colloquium on Energy Sources and Energy Conversion, Cannes, France, Mar. 1964.

Electro-fluid dynamics processes, where fluid dynamic energy is directly transformed into electrical energy by passing a working medium containing ions or charged colloids through an electrostatic field, are discussed. (R.E.U.)

44495 (ASD-TDR-63-835) A GLOW DISCHARGE PLASMA GENERATOR. George W. Loptien (Aeronautical Systems Div. Flight Dynamics Lab., Wright-Patterson AFB, Ohio). Aug. 1963. 51p. (AD-437783)

The capabilities and operating characteristics of a small-scale research facility using a d-c discharge as the energy source were determined. The goal of the program is to develop a "cold" plasma source suitable for use with a crossed-field accelerator. The apparatus consists of a continuous low-temperature electric discharge, the products of which are expanded through a supersonic nozzle into a low-pressure chamber. Air was used as the test gas. The apparatus may be operated continuously. The electrical characteristics of the discharge were determined from voltage, current, and mass flow measurements, and brief impact pressure, current collection, and stagnation temperature measurements were made in the nozzle effluent. The use of a d-c glow discharge type plasma generator for producing a "cold" plasma appears feasible. (auth)

44496 (MND-2812) RESEARCH AND DEVELOPMENT ON BARIUM VAPOR-FILLED THERMIONIC PLASMA ENERGY CONVERTERS. Quarterly Progress Report No. 1, February 19–May 18, 1962. (Martin-Marietta Corp. Aerospace Div., Baltimore). June 29, 1962. Contract AT(30-1)-2933. 71p.

An experimental and analytical evaluation of the performance of barium-vapor-filled thermionic converters, and an investigation of factors underlying the performance of the converters, are described. The development of technology necessary for the production of a long-life barium-vapor-filled converter having a high heat-sink temperature is discussed. The development of a high-temperature metal-to-ceramic seal is described. The adsorption of barium on the electrode surfaces and the plasma phenomena in the interelectrode space are studied. An apparatus for measurement of the thermionic properties in vacuum is constructed and used for a study of the aging properties of tungsten. Fabrication and testing of prototype cells are described. (T.F.H.)

44497 (MND-2812-2) RESEARCH AND DEVELOPMENT ON BARIUM VAPOR-FILLED THERMIONIC PLASMA ENERGY CONVERTERS. Quarterly Progress Report No. 2, May 21–August 17, 1962. (Martin-Marietta Corp. Aerospace Div., Baltimore). Oct. 1, 1962. Contract AT(30-1)-2933. 67p.

An experimental and analytical investigation of the performance of barium vapor-filled thermionic energy conversion devices, and an investigation of factors underlying the performance of the converters, are described. The development of the technology needed to design barium vapor-filled thermionic converters capable of long life operation with a high-temperature heat sink, and the development of a high-temperature metal-to-ceramic seal, are discussed. A general evaluation of test data is given. This discussion includes a comparison of the behavior of barium vapor-filled thermionic energy conversion devices with the behavior of cesium vapor-filled

devices. Data on thermal aging of emitters of iridium, rhodium, and molybdenum are reported. Experimental devices are tested. Because of its mechanical strength and ease of fabrication, low evaporation rate, and low neutron capture cross section, niobium is a convenient material for use in a practical system. In addition to the devices listed, device D1.1, a cylindrical electron-bombardment-heated device with an emitter of tungsten with rhenium dots, has been repaired. The device has been evacuated and outgassed, and is now ready for tests with barium vapor. The development of ceramic-to-metal seals is described. (auth)

44498 (MND-2812-3) RESEARCH AND DEVELOPMENT ON BARIUM VAPOR-FILLED THERMIONIC PLASMA ENERGY CONVERTERS. Quarterly Progress Report No. 3, August 20–November 23, 1962. (Martin-Marietta Corp. Aerospace Div., Baltimore). Jan. 1, 1963. Contract AT(30-1)-2933. 46p.

An experimental and analytical investigation into the performance of barium-vapor-filled thermionic converters, and a study of the factors underlying this performance, are carried out. The development of the technology required for design of barium-filled converters capable of long life operation at high heat-sink temperature, and development of high-temperature metal-to-ceramic seals, are described. Test data on experimental devices are presented. A flat-plate electron-bombardment-heated device is constructed. (T.F.H.)

44499 (MND-2812-4) RESEARCH AND DEVELOPMENT ON BARIUM VAPOR-FILLED THERMIONIC PLASMA ENERGY CONVERTERS. Quarterly Progress Report No. 4, November 25, 1962–March 1, 1963. (Martin-Marietta Corp. Aerospace Div., Baltimore). May 1, 1963. Contract AT(30-1)-2933. 45p.

An experimental and analytical investigation of the performance of barium-vapor-filled thermionic energy conversion devices, and an investigation of factors underlying the performance of the converters, is described. The development of the technology needed to design barium vapor-filled thermionic converters capable of long life operation with a high-temperature heat sink is discussed. The development of a high-temperature metal-to-ceramic seal is included. A detailed summary of the work carried out, and a discussion of the technology of barium vapor filled thermionic energy converters (including a comparison of the barium vapor technology to that of cesium vapor), is presented. (auth)

44500 (NASA-TN-D-2004) THREE-BODY COLLISIONAL RECOMBINATION OF CESIUM SEED IONS AND ELECTRONS IN HIGH-DENSITY PLASMAS WITH ARGON CARRIER GAS. John V. Dugan, Jr. (National Aeronautics and Space Administration. Lewis Research Center, Cleveland). Oct. 1964. 34p.

The rate of three-body recombination between cesium seed ions and electrons in an argon carrier gas is calculated for free-electron number densities of 10^{13} to 10^{18} cm^{-3} and electron temperatures of 500 to 10,000°K. Only Cs^+ ions are considered in a collisional approximation where radiative transitions are ignored. The Byron method is applied to describe collision-induced transitions between atomic energy levels by the semiclassical Gryzinski cross sections and the principle of detailed balancing. Results are in fair agreement with those of a more approximate study of potassium for 500 to 2000°K. Discussion of the results as related to conductivity in MHD power generation and comparison with recombination experiments are included. A computer program was written in FORTRAN IV for IBM 7094 for studying recombination of an atomic ion. (auth)

44501 (TE-60-64) THERMIONIC CONVERTER LIFE AND REPEATABILITY INVESTIGATION. First Quarterly Progress Report, January 2, 1964–March 31, 1964. C. Z. Kamien (Thermo Electron Engineering Corp., Waltham, Mass.). Contract AF33(615)-1348. 41p. (AD-436310)

The two major goals of the program are to develop a clear understanding of the factors that affect the life and performance of thermionic converters through the use of adequate diagnostic tools, and to acquire the technology and techniques necessary to design and fabricate experimental converters having long life and high power output on a repeatable and predictable basis. Towards these goals, life test equipment was designed to enable testing any converter for long-sustained life as well as for cyclic life evaluations. Furthermore, diagnostic facilities are incorporated in the design of the life test stations. In addition to the life test equipment, a cesium vapor, repairable thermionic converter was designed and fabricated. (auth)

44502 INVESTIGATIONS ON THE CAESIUM–MERCURY DIODE. E. Badareu, I. Popescu, C. Ghita, and O. Zamfir (Institutul de Fizica, Bucharest). Brit. J. Appl. Phys., 15: 1171-8(Oct. 1964).

The effect of the addition of mercury to a conventional cesium neutralized diode is described. A pronounced Penning effect was found, the mercury $6^3P_1-6^3D_{1,2}$ transitions being the most efficient for the volume ionization of cesium atoms. The increased electron scattering due to the introduction of mercury into the diode is to a large extent minimized by the low collision cross section, at 0.17 ev, due to the Ramsauer effect. Consequently, it appears that the performance of the diode operating under arc mode conditions may be significantly improved by the addition of mercury. (auth)

44503 A THEORETICAL STUDY OF MHD POWER GENERATION. II. THE POTENTIAL DROP NEAR THE ELECTRODES. Itaru Michiyoshi, Kunihiko Uematsu, and Massahiro Numano (Kyoto Univ.). J. Nucl. Sci. Technol. (Tokyo), 1: 188-92(Sept. 1964).

The electric potential drop near the electrode surfaces in MHD power generators was studied theoretically by considering a simple model, in which the current flows in the direction normal to the electrode surfaces. In order to simplify the situation so as to permit analytic solution, the idea of a boundary layer near the electrodes was introduced, and the problem was treated entirely macroscopically, wherein the following assumptions are made: the electrical conductivity is constant; the Hall effect and the induced magnetic field can be neglected, the behavior of the flow in the boundary layer may be described by equations for laminar flow, and the temperature variation in the boundary layer perpendicular to the electrode surfaces may be neglected. The theory predicts that the magnitude of the electric potential drop near the electrode is of the order of 10 v in typical MHD power generators. (auth)

44504 EXPERIMENTAL STUDY OF A CESIUM PLASMA CONVERTER. E. Dieulesaint and Ph. Defranould (Compagnie Francaise Thomson-Houston, Paris). J. Phys. (Paris), 25: Suppl. to No. 6, 95A-107A(June 1964). (In French)

The results of a series of tests conducted on a thermionic cesium plasma converter heated by electron bombardment are presented. Three operating modes depending on the cesium pressure were distinguished. (auth)

44505 THERMOELECTRON EMISSION OF ZIRCONIUM CARBIDE. A. P. Kazantsev, T. V. Kravchino, and T. L. Matskevich. Radiotekhn. i Elektron., 9: 1440-6(Aug. 1964). (In Russian)

Thermionic emission from zirconium carbide powders and bars was studied at 1300 to 2400°K. At 2400°K with a cathode surface potential of 5×10^4 v/cm the emission current was 37 a/cm^2. The dip of the experimental Schottky line was 1.4 times that predicted by theory. Surface ionization of cesium on ZrC was subject to the Saha-Langmuir law. (tr-auth)

44506 SOME PROBLEMS OF THE MAGNETOHYDRODYNAMIC GENERATOR WITH CONSTANT CROSS SECTION OF THE CHANNEL. Zbigniew Jasicki and Aleksander Kordus. Rozprawy Elektrotech., 10: 227-36(1964). (In Polish)

The description of the magnetohydrodynamic generator constructed at the Engineering College in Poznan is presented. The work of the generator with constant cross section canal and continual electrodes in the direct and variable magnetic field is discussed. The construction of the canal, influence of impurities, electrode systems, and theoretically obtained powers are described. The results of experiences achieved with electrodes and secondary effects which give considerable differences in comparison with the theory are considered. (auth)

44507 PLASMOTRON AS SOURCE OF PARTIALLY IONIZED GASES. Czeslaw Krolikowski and Stefan Seidel. Rozprawy Elektrotech., 10: 237-55(1964). (In Polish)

Basic problems which are connected with receiving a stream of partially ionized gases for MHD purposes are discussed. Also existing certain thermodynamic relations were presented for electrode—nozzle of de Laval type. Tests were made in order to fix the thermal balance of the plasma jet applied in the MHD generator. (auth)

44508 LOW-VOLTAGE ARC IN CESIUM VAPORS. Yu. K. Gus'kov, M. A. Lebedev, and I. P. Stakhanov. Zh. Tekhn. Fiz., 34: 1451-61(Aug. 1964). (In Russian)

Investigations were made of the low-voltage arcs in cesium vapor. The burning potential and plasma density were studied under conditions in which the free-path length is small in comparison to intraelectrode distance. (tr-auth)

Elementary Particles and Radiations

Refer also to abstract 44831.

44509 (AD-604581) A STUDY OF DI-PION RESONANCES PRODUCED AT LOW MOMENTUM TRANSFER IN $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ AT 1.6 Bev/c (thesis). Technical Report No. 35. Alan R. Clark (Princeton Univ., N. J.). Aug. 28, 1964. Contract Nonr-1858(06). 95p.

Spark chamber spectrometers were used to investigate the dipion mass spectrum over the mass range 450 to 1000 Mev. The dipions were produced in the reaction $\pi^- + p \rightarrow \pi^- + \pi^+ + n$ at an incident momentum of 1.6 Bev/c. More than 6000 events were obtained with a mass resolution of ±4 Mev. The apparatus was designed to select primarily events made with low 4-momentum transfer (Δ) to the recoil nucleon; the events are accordingly restricted to the range $\Delta < \sim \Delta_{min} + 2\ \mu$, where Δ_{min} is the lower kinematic limit on Δ, and μ is the pion mass. The geometry also restricts the data to $|\cos\theta_{\pi\pi}| < \sim 0.4$, where $\theta_{\pi\pi}$ is the $\pi\pi$ scattering angle, defined in the $\pi\pi$ cms. The dipion mass spectrum shows a strong contribution from the ρ^0 meson centered at ~740 Mev with a width on the order of 130 Mev. There is no evidence of any other structure in the spectrum. The branching ratio $(\omega \rightarrow \pi^+\pi^-)/(\text{all}\,\omega)$ is consistent with zero with an upper limit of 1.6%. The data can be interpreted fairly well within the framework of the one-pion exchange model (OPE), but the distributions of the Treiman-Yang angle and the π-n effective masses indicate the presence of non-OPE processes. The distributions could be explained by the formation of a recently reported $I = \frac{1}{2}$ π-N state with a mass of 1.4 Bev. The differential $\pi\pi$ scattering cross section $(d\sigma_{\pi\pi}/d\cos\theta_{\pi\pi})$ was calculated at 90°. Comparisons with other measurements of the total cross section show a much larger resonant contribution to our data than expected from OPE; this effect can be explained by a depolarization of ~35% of the ρ due to ρ-N final state absorption. (auth)

44510 (BNL-8268) ANTI-ISOBAR PRODUCTION IN $\bar{p}n$ INTERACTIONS. T. C. Bacon, H. W. K. Hopkins, D. K. Robinson, E. O. Salant (Brookhaven National Lab., Upton, N. Y.); A. Engler, H. E. Fisk, C. M. Meltzer, and J. B. Westgard (Carnegie Inst. of Tech., Pittsburgh). [1964]. Contract [AT(30-2)-Gen-16]. 13p. (CONF-550-53)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Single-pion-production in $\bar{p}$-n interactions at incident antiproton momentum of 1960 ± 25 Mev/c was studied in a deuterium bubble chamber. Production of the $(\frac{3}{2}, \frac{3}{2})$ antiisobar was observed, and is discussed in terms of one-pion-exchange model. (auth)

44511 (BNL-8311) STRANGE PARTICLE PRODUCTION IN π^+ p INTERACTIONS AT π^+ MOMENTA OF 1.39, 1.76, AND 2.08 Gev/c. Horst W. J. Foelsche, A. Lopez-Cepero, C.-Y. Chien, and H. L. Kraybill (Yale Univ., New Haven and Brookhaven National Lab., Upton, N. Y.). [1964]. Contract [AT(30-2)-Gen-16]. 9p. (CONF-550-57)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Cross sections for various reactions of π^+-p, including Y_1^* (1385) and K^*(885), are given. Mass distributions are shown. (R.E.U.)

44512 (BNL-8312) MULTIPLE PION PRODUCTION (WITHOUT ANNIHILATION) IN $\bar{p}$-p COLLISIONS AT 7 Bev/c. T. Ferbel, A. Firestone, J. Johnson, H. Kraybill, J. Sandweiss, and H. D. Taft (Yale Univ., New Haven and Brookhaven National Lab., Upton, N. Y.). [1964]. Contract [AT(30-2)-Gen-16]. 12p. (CONF-550-54)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Multipion production in antiproton-proton interactions at 6.94 Bev/c was studied, with emphasis on double-pion production. Cross sections were measured, and comparisons were made with one-pion exchange predictions. (R.E.U.)

44513 (BNL-8313) PRODUCTION OF PIONS IN π^+ p COLLISIONS AT 2.08 Gev/c. F. E. James and H. L. Kraybill (Yale Univ., New Haven and Brookhaven National Lab., Upton, N. Y.). [1964] Contract [AT(30-2)-Gen-16]. 8p. (CONF-550-56)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Two- and four-pronged interactions of π^+ at 2.08 Bev/c in a 20-in. hydrogen bubble chamber were studied. Mass

distributions for multipion resonances and the $(^3/_2, ^3/_2)$ nucleon isobar are shown. (R.E.U.)

44514 (BNL-8314) SINGLE PION PRODUCTION AND MULTIPLE PION ANNIHILATIONS IN $\bar{p}$-p INTERACTIONS AT 7 Bev/c. T. Ferbel, A. Firestone, J. Johnson, H. Kraybill, J. Sandweiss, and H. D. Taft (Yale Univ., New Haven and Brookhaven National Lab., Upton, N. Y.). [1963]. Contract [AT(30-2)-Gen-16]. 12p. (CONF-550-55)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Preliminary results of $\bar{p}$-p interaction studies at antiproton beam momentum of 6.94 Bev/c are presented. Cross sections, single-pion production, and annihilation of the $\bar{p}$-p system into pions are considered. (R.E.U.)

44515 (BNL-8323) TOTAL CROSS SECTIONS OF PROTONS, ANTIPROTONS, π MESONS AND K MESONS ON HYDROGEN AND DEUTERIUM IN THE MOMENTUM RANGE 6-22 Gev/c. W. Galbraith, E. W. Jenkins, T. F. Kycia, B. A. Leontic, R. H. Phillips, A. L. Read (Brookhaven National Lab., Upton, N. Y.); and R. Rubinstein (Cornell Univ., Ithaca, N. Y.). [1964]. Contract [AT(30-2)-Gen-16]. 16p. (CONF-550-60)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Experimental procedures and results are described. (R.E.U.)

44516 (BNL-8328) 10-30 Bev/c ELASTIC SCATTERING OF π^+ + p, p + p, $\bar{p}$ + p AND K^+ + p OVER THE $|t|$ RANGE 0.0005 TO 1 $(Bev/c)^2$. K. J. Foley, R. S. Gilmore, R. S. Jones, S. J. Lindenbaum, W. A. Love, S. Ozaki, E. H. Willen, R. Yamada, and L. C. L. Yuan (Brookhaven National Lab., Upton, N. Y.). [July 28, 1964]. Contract [AT(30-2)-Gen-16]. 20p. (CONF-550-58)

From the International Conference on High-Energy Physics, Dubna, USSR, Aug. 1964.

Preliminary results are given for p-p at 15 to 25 Bev/c, K^--p at 12 to 16 Bev/c, $\bar{p}$-p at 7 to 16 Bev/c, and π^--p at 15 to 25 Bev/c. (R.E.U.)

44517 (CERN-64-38) DISCRIMINATION CINEMATIQUE DES EVENEMENTS INELASTIQUES DANS LA DIFFUSION ELASTIQUE A GRAND TRANSFERT. (Kinematic Discrimination of Inelastic Events in High-Transfer Elastic Scattering). J. Banaigs, C. Bonnel, L. Goldzahl, E. G. Michaelis, and F. Plouin (European Organization for Nuclear Research, Geneva). July 28, 1964. 37p.

In the region of high momentum transfers, the elastic scattering cross sections become very weak. Purely kinematic criteria for the recognition and elimination, if possible, of the contribution of inelastic scattering are studied from the viewpoint of their measurement. Two particularly unfavorable cases were discussed: formation of a resonant state of one of the particles and creation of a neutral particle at rest in the laboratory or in the center-of-mass systems of the incident particles. The application of these calculations to a particular experimental apparatus shows that a very important discrimination factor can be obtained, in the region studied, by appropriate magnetic and angular selection. (tr-auth)

44518 (LAMS-3030) NUCLEAR PHYSICS APPLICATIONS OF A HIGH-FLUX MESON FACILITY. L. Rosen (Los Alamos Scientific Lab., N. Mex.). Dec. 2, 1963. Contract W-7405-eng-36. 12p.

Economic and technical aspects and projected uses of a "pion factory" using a linac capable of 1 mamp of 800-Mev protons are discussed. Some nuclear physics studies, which could be accomplished using the mesons, are described. (R.E.U.)

44519 (NEVIS-123) AN EXPERIMENTAL ANALYSIS OF π^+-p TWO-PRONG EVENTS AT 2.35 AND 2.90 Bev/c (thesis). Tai Ho Tan (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Labs.). May 1964. Contract AT(30-1)-1932. 59p.

A total of 60,000 pictures at incident pion momenta of 2.35 and 2.90 Bev/c were taken by exposing a 20-in. hydrogen bubble chamber to a π^+ separated beam in order: (a) to measure cross sections for one-pion production processes, in particular, those involving the formation of π-π resonant states, so as to study their mechanisms; (b) to search for neutral decay modes of ρ, ω, and η; and (c) to extract information concerning the structure of the elastic scattering peak in the incident pion momentum range of 2 to 3 Bev/c. A total of 7812 two-prong events were analyzed; of these, 2120 events fitted elastic scattering. The forward elastic scattering peaks for both energy regions seem to decrease exponentially with the increase of Δ^2; i.e., square of four-momentum transfer to the proton. Within statistical limits, there is no difference in the structure of the diffraction peaks at incident pion momenta of 2.35 and 2.90 Bev/c. 1624 events were identified as π^0 production, in which roughly 35% were characterized by ρ^+ formation, and 10% by N^* intermediate state. For $\Delta \leq 500$ Mev, the idea that ρ^+ is formed via single-pion exchange is tested by using the Treiman-Yang suggestion and by studying the π-π angular distribution. Departure of these ρ^+ productions from the single-pion exchange model is observed. By plotting the "neutral" mass spectrum from the reaction $\pi^+ + p \rightarrow \pi^+ + p +$ "neutrals," the ratio of $(\eta \rightarrow \text{neutrals}/\eta \rightarrow \pi^+ + \pi^- + \pi^0)$ is estimated to be 2.7 ± 0.3, while that of $(\omega \rightarrow \text{neutrals}/\omega \rightarrow \pi^+ + \pi^- + \pi^0)$ is estimated to be 0.10 ± 0.04. No evidence about the nature of the neutral decay products of either η or ω is found in this experiment. From the events $\pi^+ + p \rightarrow \pi^+ + \pi^+ +$ neutrals, 984 events were identified as $\pi^+ + p \rightarrow \pi^+ + \pi^+ + n$. No indication was found for $(\pi^+\pi^+)$ resonances in the range of the dipion masses up to 1500 Mev, or of $(\pi^+ n)$ resonances in the range of the pion-nucleon effective masses up to 2350 Mev. (auth)

44520 (NEVIS-125) EXPERIMENTAL SURVEY OF STRANGE PARTICLE DECAYS. Jack Steinberger (Columbia Univ., Irvington-on-Hudson, N. Y. Nevis Labs.). June 1964. Contract AT(30-1)-1932. 54p. (CU-231; R-445)

Strange particle decays are discussed in a series of three lectures given at the International School of Physics "Enrico Fermi," Varenna, Italy. A theoretical background is used to describe the K meson decays, hyperon decays, and selection rules. 61 references. (R.E.U.)

44521 (TID-21205) LOW-ENERGY K^- MESON INTERACTIONS IN HYDROGEN (thesis). Technical Report No. 410. Mark Sakitt (Maryland. Univ., College Park). Sept. 1964. Contract AT(40-1)-2504. 76p.

Low energy K^- meson interactions in hydrogen were studied in the following channels: $K^- + p \rightarrow K^- + p$, $K^- + p \rightarrow \Sigma^- + \pi^+$, and $K^- + p \rightarrow \Sigma^+ + \pi^-$. Cross sections, as a function of momentum, are presented for (60 to 300) Mev/c K^- laboratory momenta. The cross sections, combined with existing data, are used to fit the zero-effective-range theory of Dalitz and Tuan. Two possible solutions are obtained; the preferred one agrees with previous higher energy data. The favored solution also suggests an S-wave bound state at 1410 Mev, which could be associated with the

Y_0^* at 1405 Mev whose spin is still undetermined. Various properties of the two solutions are presented, for K^-p interactions and K_{2p}^0 interactions. (auth)

44522 (UCRL-11432) BETA DECAY OF THE LAMBDA HYPERON (thesis). William Joshua Singleton (California. Univ., Berkeley. Lawrence Radiation Lab.). May 5, 1964. Contract W-7405-eng-48. 79p.

Lambda hyperons were produced by stopping K^- mesons in a 30-inch bubble chamber filled with a CF_3Br–24% C_3H_8 mixture by weight. A total of 230,000 useful pictures was taken and scanned for decays of the type $\Lambda \rightarrow p + e^- + \bar{\nu}$ and for the normal decay mode $\Lambda \rightarrow p + \pi^-$. There were 192,000 Λ decays in the film. Three methods for identifying Λ_β decays were used. The most successful method of determining the branching ratio $r = (\Lambda \rightarrow p + e^- + \bar{\nu})/[(\Lambda \rightarrow p + \pi^-) + (\Lambda \rightarrow n + \pi^0)]$ made use of the Λ_β decays with electron tracks that either stopped in the chamber or had high curvature. The remaining β-decay candidates were selected by kinematics or by δ rays. the best value obtained is $r = (0.82 \pm 0.13) \times 10^{-3}$. The form of the Λ_β decay interaction was studied by measuring the distributions of proton transverse momentum and of the angle between the proton and electron projected on the plane normal to the Λ direction. Measurement errors and selection biases were folded into the theoretical distributions for different forms of the interaction. Comparison of the modified theoretical distributions with the experimental data shows that a pure tensor interaction is ruled out with 99% confidence. Assuming the interaction to be only V and A, $|C_A/C_V| > 0.5$ with 99% confidence. Both V-A and pure axial vector interactions are compatible with the data. (auth)

44523 (UCRL-11568) SIGMA-PION FINAL-STATE INTERACTIONS (thesis). Yu-li Pan (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1964. Contract W-7405-eng-48. 74p.

Sigma hyperons produced with two pions by 1.15-Bev/c K^- on neutrons in a 30-inch propane bubble chamber were used to study final-state interactions of the particles. The production of Y_1^* (1385) on protons in carbon was also studied. The Y_1^* (1385), Y_0^* (1405), and Y_0^* (1520) were observed. In addition, the data indicates the existence of a T = 2 sigma-pion resonance at (1415 ± 16) Mev, with full-width at half-maximum of 50 Mev or less. The spin and parity of this resonance were not determined. The data show a possible resonance in the region of 1750 Mev in the reactions $\Lambda\pi^-\pi^+$ and $\Sigma^\pm\pi^\mp\pi^-$. This may be associated with the decay of the 1765-Mev Y_1^* into these channels. The production cross sections for $\Sigma^-\pi^-\pi^+$ and $\Sigma^+\pi^-\pi^-$ reactions are (0.51 ± 0.07) mb and (0.45 ± 0.07) mb, respectively. (auth)

44524 THE STRUCTURE OF THE PROTON AND THE NEUTRON. H. Schopper (Technische Hochschule, Karlsruhe, Ger. and Kernforschungszentrums, Karlsruhe, Ger.). Angew. Chem. Intern. Ed. Engl., 3: 597-601(Sept. 1964).

A short review is given on the present state of knowledge on the structure of the proton and neutron. The results so far obtained have been derived from studies of the scattering of fast electrons. (auth)

44525 CONTRIBUTION TO THE STUDY OF RELATIVISTIC CORRECTIONS TO THE WAVE FUNCTION OF THE DEUTERON AND TO ELECTRON-DEUTERON ELASTIC SCATTERING. Jean Tran Thanh Van (Faculte des Sciences, Orsay, France). Ann. Phys. (Paris) (13), 9: 139-78(Mar.-Apr. 1964). (In French)

The problem of the deuteron formed of two fermions is considered. A covariant study is first made of the wave function of the deuteron using the Bethe-Salpeter equation and the equation of the neutron–proton–deuteron vertex. The electron-deuteron elastic scattering is then studied using the hypothesis of the exchange of a single photon and the electromagnetic current of the deuteron in this approximation. The various approximations that make possible the connection of the various form factors of the deuteron to those of the nucleon are investigated. The matrix element of the electromagnetic current of the deuteron was formally calculated. The form factors of the deuteron within the Born approximation for the N–P–D vertex were studied. A separable interaction was used to calculate the structure functions. (J.S.R.)

44526 ON THE PSEUDOSCALAR TERM IN THE LEPTON PHOTOPRODUCTION PROCESS. Z. Smigielski (Univ. of Warsaw). Bull. Acad. Polon. Sci., Ser. Sci., Math., Astron. Phys., 12: 335-7(1964).

The effective cross section of the process $\gamma + p \rightarrow \mu^+ (e^+) + n + \nu$ was calculated in the first order of weak and electromagnetic interactions. It was shown that the contribution of the pseudoscalar term to the cross section is roughly 10^3 times larger than those of the vector and axial vector terms. (auth)

44527 ELASTIC SCATTERING OF π MESONS WITH A MOMENTUM OF 4.0 Bev/c ON PROTONS. A. I. Zlateva, P. K. Markov, T. Todorov, and Kh. M. Chernev. Compt. Rend. Acad. Bulgare Sci., 16: 581-3(1963). (In Russian)

The photoemulsion method was used to study elastic π-p scattering at 4.0 Bev/c. A total of 164 elastic events were identified. The differential cross sections in the region 3–15° in the cms are given. They are compared with the corresponding values calculated according to C. Lovelace. The differences between the experimental and calculated values increase with the scattering angle. (auth)

44528 RIGHT-HANDED AND LEFT-HANDED COORDINATE SYSTEMS IN THEORY OF PARTICLES WITH SPIN 1/2. J. Formánek (Czech. Tech. Univ., Prague). Czech. J. Phys., 14: 657-66(1964).

It is shown that unobserved processes, which are usually eliminated from the theory by the introduction of muon parity, can be forbidden on the basis of spatial properties. (auth)

44529 THE SINGULARITY OF JOST FUNCTIONS AND POTENTIALS. J. Lanik (Inst. of Physics, Bratislava). Czech. J. Phys., 14: 667-77(1964).

Definite analytical properties of the Jost functions are postulated, and their appropriate potentials are sought. It is found that for the case of the simplest singularities of the Jost functions (poles on the positive side of the imaginary axis of the complex plane k and poles at the point k = 0 to the order l), this inversion problem of the potential scattering leads to the solution of a definite system of nonlinear differential equations of the second order. Finally, the generalized Noyes-Wong equation is derived, and it is proved that this equation is not homogeneous when the potential for r very large decreases exponentially and is homogeneous when, for large r, the potential decreases rationally ($\sim r^{-3}$). (auth)

44530 INTERACTIONS OF MESONS. V. S. Barashenkov (Joint Inst. for Nuclear Research, Dubna, USSR). Fortschr. Physik, 12: 347-85(1964).

Cross sections for the π–π interaction and the 2-π resonances, resonances in the 3-π system, many-π resonances, the K-π interaction, and interaction of mesons(K) are discussed. A bibliography of 116 references is included. (C.E.S.)

44531 FORMULAS FOR ELASTIC SCATTERING OF HIGH-ENERGY PARTICLES. S. A. Azimov and G. G. Arushanov (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk, No. 2, 69-76(1964). (In Russian)

Corrections are given for the formulas developed by D. I. Blokhintsev (Zh. Eksp. Teoret. Fiz., 42: 880(1962)) for elastic backward scattering of high-energy particles at 180°. (R.V.J.)

44532 REMARKS ON THE RESONON THEORY. V. I. Kushtan (Moscow State Univ.). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 4, 105-8(1964). (In Russian)

A variation of G. Chew's (Phys. Rev. 112: 1380(1958)) approximation method for resonance analysis is discussed. It is shown that it is possible to find the resonance quantum numbers without precise data on their masses and bonding constants. The suggested method was used in an analysis of K* resonances. The mass, spin, and parity data obtained were in good agreement with experimental data. (tr-auth)

44533 METHOD OF PHASE PERTURBATION IN INVERSE SCATTERING PROBLEM. A. A. Kostarev (Odessa Construction Engineering Inst.). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 4, 109-12(1964). (In Russian)

An approximation method is suggested for the Marchenko solution of the inverse scattering problem using the phase perturbation method. Universal equations were developed for approximations of any arbitrary order. (tr-auth)

44534 COMPLEX ANGULAR MOMENTA AND MANY-PARTICLE STATES. I. PROPERTIES OF LOCAL REPRESENTATIONS OF THE ROTATION GROUP. M. Andrews and J. Gunson (Univ. of Birmingham, Eng.). J. Math. Phys. (N. Y.), 5: 1391-1400(Oct. 1964).

The properties of the "local representations" of the rotation group corresponding to complex angular momentum are further developed. Completeness and bi-orthogonality relations are derived; and a reduction of products is carried out, giving a generalization of the Clebsch–Gordan reduction. The connection with the representation theory of the group SL(2,R) is considered, and a generalization of Regge's use of the Sommerfeld–Watson transform is made to the case in which three momentum transfer variables occur in the description of scattering amplitudes. (auth)

44535 PROTON-PROTON INTERACTIONS AT MULTI-Bev ENERGIES. Mujaddid A. Ijaz (Ohio Univ., Athens). J. Nat. Sci. Math., 4: 33-49(Apr. 1964).

The proton-proton interactions in the Bev range were reviewed. The experimental techniques used to measure the interaction cross section, the particles produced, and the energy and momentum distribution of these particles were discussed briefly. The data are compared with various models proposed to explain the behavior of elastic and inelastic cross section at high energies. The slow decrease in elastic cross section with increase in energy is in good agreement with Regge hypothesis. Some features of the inelastic scattering are still not resolved by any existing theory and therefore more detailed experimental data and theoretical work are needed to understand the interaction mechanism and the structure of the nucleon at multi-Bev energies. (auth)

44536 FERMI INTERACTIONS AT HIGH ENERGIES. G. Domokos, P. Surányi, and A. Vančura (Joint Inst. for Nucl. Research, Dubna, USSR). Nucl. Phys., 60: 1-16(Nov. 1964).

The behavior of the four-lepton vertex at high energies is investigated in the ladder approximation, assuming the existence of an elementary Fermi interaction of the V-A type. (D.C.W.)

44537 COVARIANT SPIN OPERATOR FOR A KEMMER PARTICLE. P. M. Mathews and A. Sankaranarayanan (Univ. of Madras). Nucl. Phys., 60: 65-9(Nov. 1964).

It is shown that the total angular momentum of a Kemmer particle can be split up into orbital and spin parts that are individually conserved and covariant, using the approach of Hilgevoord and Wouthuysen for the case of Dirac particles. The spin operator obtained from the space-space part of this spin tensor is compared with another (non-covariant) "observable" spin operator derived from a canonical formalism. (auth)

44538 DETERMINATION OF THE INVARIANT AMPLITUDES FOR PHOTOPRODUCTION OF PIONS FROM EXPERIMENTAL DATA. Bo Andersson (Univ. of Lund, Sweden). Nucl. Phys., 60: 144-60(Nov. 1964).

Explicit formulas are derived which express the four invariant amplitudes of the S-matrix for pion photoproduction in terms of experimental data. For a complete determination, the results of at least eight experiments at each angle and energy are required. In particular, experiments with linearly polarized photons and polarized targets are discussed in some detail. (auth)

44539 WEAK INTERACTIONS WITH INTERMEDIATE BOSON. Pierre Hillion (Institut Henri Poincaré, Paris). Nucl. Phys., 60: 169-76(Nov. 1964). (In French)

A theory characterizing weak interactions by their invariance under the W-R_3 group (a rotation group, the domain of which is the isospace $\mathfrak{C}(R_3^c)$) is presented, in which an intermediate boson is assumed. (auth)

44540 JETS WITH STRANGE PARTICLES PRODUCED BY 25 Gev/c PROTONS ON PROTONS. A. de Marco-Trabucco (Università, Turin), L. Montanet, and S. Nilsson. Nucl. Phys., 60: 209-21(Nov. 1964).

Jets with mesons(K) or hyperons produced by 25-Bev/c protons were analyzed. The fraction of the baryon total energy going into production of mesons is 0.45 ± 0.03 in the p-p center-of-mass system. There is a strong correlation between total energy in the center-of-mass system and the number of charged prongs for hyperons, but no correlation for mesons. The pion laboratory energy distribution is proportional to $E_{lab}^{-1.53 \pm 0.27}$ (between 1 and 5 Bev), and the hyperon distribution is proportional to $E_{lab}^{-0.94 \pm 0.15}$ (between 2 and 15 Bev). The meson(K) energy distribution cannot be described by a simple power law. High-energy pions (above 8 Bev) are almost absent, indicating that there is no abundant production of nucleon excited states in the forward direction. The average number of pions interactions with YK is 4.3 ± 0.6, while with $K\overline{K}$ it is 3.7 ± 0.4. The results are discussed in terms of different theoretical models. (auth)

44541 DEUTERON POLARIZATION FOLLOWING ELASTIC SCATTERING OF POSITIVE PIONS. R. K. Umerjee (MATSCIENCE, Inst. of Mathematical Sciences, Madras). Nucl. Phys., 60: 313-28(Nov. 1964).

The spin state of the deuteron following elastic scattering of mesons(π^+) is studied in impulse approximation, using the Chew-Low amplitude for π-N scattering. Taking into consideration only the dominant δ_{33} phase shifts, it is found that the deuteron "polarization" vanishes and that the differential alignment parameter is independent of the incident pion energy. (auth)

44542 A COMPLETE CLASSIFICATION OF THREE-NUCLEON STATES. T. Kalotas and L. M. Delves (Univ. of New South Wales, Kensington, Australia). Nucl. Phys., 60: 363-8(Dec. 1964).

The classification of three-nucleon states given for the

triton ($J = \frac{1}{2}$, $\pi = +$) is extended to states of arbitrary J^{π}. (auth)

44543 ISOBAR PRODUCTION IN NUCLEON-NUCLEON COLLISIONS. Alladi Ramakrishnan, K. Raman, and R. K. Umerjee (MATSCIENCE, Inst. of Mathematical Sciences, Madras). Nucl. Phys., 60: 401-26(Dec. 1964).

Single-isobar production in NN collisions is considered in a model in which the amplitude is approximated by the exchange of the different multi-pion resonances. It is shown that contributions other than single-pion exchange are important in understanding the isobar production process. Total cross sections, c.m. energy spectra, and c.m. angular distributions are calculated for different assumptions about the form factors, and the type of information that can be derived from each is discussed. The results of the calculation are compared with experimental data, and experiments are outlined that permit a better understanding of the mechanism of isobar production to be achieved. (auth)

44544 THE LONG-RANGE PARTS OF THE Λ-N AND Λ-Λ POTENTIALS. Y. Nogami, B. Ram, and I. J. Zucker (Battersea Coll. of Tech., London). Nucl. Phys., 60: 451-64(Dec. 1964).

The two-pion exchange contributions to the Λ-N and Λ-Λ potentials are obtained on the basis of the Mandelstam representation of the scattering amplitude. Formulas for V_0, V_s, and V_T in the expression $V = V_0 + V_s(\sigma_1 \cdot \sigma_2) + V_T S_{12} + \ldots$, where $(\sigma_1 \cdot \sigma_2)$ and S_{12} are defined elsewhere, are given in terms of the parameters related to the π-N and π-Λ scattering amplitudes. The quantity V_0 involves the S-wave π-Λ scattering amplitude, which is experimentally unknown; V_s and V_T depend only on the P-wave π-N and π-Λ interactions, which are assumed to be dominated by the 3-3 resonance N* and the Y_1^* resonance (1385 Mev) respectively. Higher partial waves are ignored. Only V_s and V_T are evaluated numerically. It is found that V_s and V_T are extremely small. This implies that the strong spin-dependence of the phenomenological Λ-N force is characteristic of the short-range part of the potential. (auth)

44545 THE NEUTRON-PROTON RESIDUAL INTERACTION IN A QUASI-PARTICLE REPRESENTATION. Lars Silverberg (Inst. of Theoretical Physics, Lund, Sweden). Nucl. Phys., 60: 483-96(Dec. 1964).

In a shell model calculation, with an nn and pp force of pure pairing force type, the np force is treated in first-order perturbation. The np force then appears as a renormalization of the single-particle energies. It is shown that even for a very complicated np interaction, the only important term is the Slater integral for a pure Wigner force and k = 0. Concerning the nuclear systematics, this corresponds to a change of the static field, which for a δ interaction is proportional to the mass distribution of the added pairs. Some regions where the coupling scheme is supposed to work are considered in detail. A qualitative discussion explains all the experimentally observed systematic trends in a natural way. Quantitative calculations are further performed using some expected functional dependence of the Slater integrals or a physical two-body force. Agreement between theory and experiment is generally found. Finally the influence this np force has on the B values for γ transitions is discussed. (auth)

44546 SU_3 MESON-BARYON MODEL WITH SMALL SYMMETRY-BREAKING INTERACTION. Robert L. Anderson (General Motors Corp., Warren, Mich.) and Suraj N. Gupta. Nucl. Phys., 60: 518-20(Dec. 1964).

It is shown by means of second-order calculations that the SU_3 model with small symmetry-breaking interaction leads to the difficulty of a negative intrinsic mass for baryons. It is concluded that a certain derivation of the mass formulae cannot be regarded as satisfactory unless it is established that the higher-order effects are able to remove this difficulty. (auth)

44547 LARGE SYMMETRY-BREAKING MESON-BARYON INTERACTIONS. Robert L. Anderson (General Motors Corp., Warren, Mich.) and Suraj N. Gupta. Nucl. Phys., 60: 521-8(Dec. 1964).

The general structure of the symmetry-breaking meson-baryon interactions within the framework of the three-dimensional unitary-unimodular group is investigated. It is suggested that the symmetry-breaking terms are not necessarily small compared with the symmetry-preserving terms, and that the mass formulae for mesons and baryons follow as a result of certain cancellations in the self-energies of these particles. An estimate based on the second-order self-energy calculations leads to an intrinsic mass of about 870 Mev for mesons as well as baryons, and accounts for all the observed mass splittings between the meson and baryon multiplets in terms of the symmetry-breaking interactions. (auth)

44548 THE PARTIAL WAVE AMPLITUDE FOR HIGH-ENERGY PION-PION SCATTERING. P. Olesen (Universitet, Copenhagen). Nucl. Phys., 60: 641-54(Dec. 1964).

An approximate solution to the N/D equations is obtained in the high-energy region. The solution depends on the high-energy behavior of N(ν), on the inelasticity R(ν) and on the partial wave dispersion integral over the left-hand cut. If one assumes that the diffraction picture correctly describes the high-energy dynamics, and if the function N(ν) is sufficiently smooth at high energies, it is possible to obtain an integral equation for the inelasticity. Using the solution to this equation, the high-energy partial wave amplitude is then shown to depend only on the real part of the partial wave amplitude. The latter can be described approximately in terms of low-energy dynamics if the high-energy dynamics is peripheral. Thus, in this case, the unknown high-energy region can be determined in terms of the known low-energy region. If (as is indicated by some experimental data) the high-energy dynamics is central, the high-energy amplitude originates from a "bootstrap" mechanism. (auth)

44549 BROKEN SYMMETRY AND MASSLESS INTERACTION FREE BOSONS. E. van der Spuy (Atomic Energy Board, Pelindaba, S. Africa). Nucl. Phys., 60: 686-93 (Dec. 1964).

If one starts with a fundamental spinor field equation such as $i\hat{\nabla}\psi(x) = l^2 T(\bar{\psi}(x)O^l\psi(x))O_i\psi(x)$, which is invariant under a continuous group of transformations, and which consequently permits a conserved current, and if the vacuum state is not invariant under the same group, one can show, using τ-functions, that compound bosons arise which have no mass but also are without interaction. This will hold unless certain boundary conditions are assumed for the field solutions or unless a symmetry breaking interaction is introduced into the fundamental equation. Some other aspects of the problem and the work of other authors are discussed. (auth)

44550 SOME RESULTS CONCERNING THE PRODUCTION OF HYPERFRAGMENTS AND THE GENERAL PROPERTIES OF THE INTERACTIONS OF K^- MESONS OF 3 Gev/c WITH THE NUCLEI OF PHOTOGRAPHIC EMULSIONS. G. Baumann, J. P. Gerber, H. Braun, and P. Cueer (Centre de Recherches Nucleaires, Strasbourg). Nuovo Cimento (10), 34: 265-73(Oct. 16, 1964). (In French)

Interactions occurring with and without emission of hyperfragments were compared. The interactions with hyperfragment production produce larger stars than the normal interactions. The rate of hyperfragment production is about 2.5 ± 0.5%, notably smaller than in meson (K^-) interactions at lower energy. The number of very heavy hyperfragments is lower than in interactions at lower energy, and their mean energy appears to be higher. (tr-auth)

44551 GREEN'S FUNCTIONS OF VECTOR THEORIES. G. Pocsik (Lorand Eötvös Univ., Budapest). Nuovo Cimento (10), 34: 287-92(Oct. 16, 1964).

Green's functions of neutral vector meson theories are discussed in a Bloch-Nordsieck-like approximation. In the Green's functions the B-field is traced in detail. (auth)

44552 NEUTRINO PRODUCTION OF LEPTON PAIRS THROUGH THE POINT FOUR-FERMION INTERACTION. W. Czyz (Inst. of Nuclear Physics, Krakow), G. C. Sheppey, and J. D. Walecka. Nuovo Cimento (10), 34: 404-25(Oct. 16, 1964).

The total cross sections for production of lepton pairs through the point four-fermion interaction by high-energy neutrinos and antineutrinos in the nuclear electromagnetic field are calculated numerically from the threshold up to very high energies where the asymptotic formulas are applicable. The asymptotic cross sections are calculated analytically and found to be (for high enough energies) in excellent agreement with the exact numerical calculations. The importance of such detailed calculations, especially in the search for the intermediate vector boson, is stressed. Details of the invariant phase-space calculations are included. (auth)

44553 A COVARIANT THEORY OF THE PHOTODISINTEGRATION OF THE DEUTERON. [PART] II. M. Le Bellac, F. M. Renard, and J. Tran Thanh Van (Université de Paris, Orsay, France). Nuovo Cimento (10), 34: 450-72(Oct. 16, 1964).

The photodisintegration of the deuteron is calculated from threshold to 150 Mev by means of a covariant theory. The Born approximation was previously computed; dispersion relations are now used so as to take into account the final-state interaction of the nucleons, taking from experiment the nucleon-nucleon phase-shifts. The exchange currents are estimated in a semi-phenomenological way, in order to obtain the experimental value of the neutron-proton radiative capture. The photodisintegration very near threshold is calculated at energies of 2.504, 2.618, and 2.755 Mev, and a careful comparison is made with experiment. From 3 to 130 Mev, the theory is in very good agreement with experiment; results for total and differential cross sections, nucleon polarization, cross section with linearly polarized γ rays are given at energies of 22.2, 34, 52.3, 90, and 107.3 Mev, and compared with experimental results when available; this permits the determination of a useful parametrization of the neutron-proton-deuteron vertex. (auth)

44554 RESONANCES IN THE PSEUDOSCALAR MESON-VECTOR MESON SYSTEM AND SU_3 SYMMETRY. S. Minami (Louisiana State Univ., Baton Rouge). Nuovo Cimento (10), 34: 492-4(Oct. 16, 1964).

The possibility that the mesons (B) and (C) belong to a pseudoscalar octet while the mesons (D) and (f^0) belong to a 2^+ octet is pointed out. (C.E.S.)

44555 INVESTIGATION OF EXCHANGE MECHANISMS IN THE REACTION $\pi^+ p \rightarrow p\pi^+\pi^0$ AT 4 Gev/c. M. Aderholz (Technische Hochschule, Aachen), J. Bartsch, L. Bondar, et al. Nuovo Cimento (10), 34: 495-500(Oct. 16, 1964).

A hydrogen bubble chamber was used to investigate the exchange mechanisms in the reactions $\pi^+ + p \rightarrow p + \rho^+$ and $\pi^+ + p \rightarrow N^{*++} + \pi^0$ at an incident momentum of 4 Bev/c. Photographs of 1278 events of the type $\pi^+ + p \rightarrow p + \pi^+ + \pi^0$ were analyzed. (C.E.S.)

44556 X^0-MESON (960 Mev) PRODUCTION IN K^--p COLLISION AND DETERMINATION OF ITS SPIN-PARITY. S. Minami and R. F. O'Connell (Louisana State Univ., Baton Rouge). Nuovo Cimento (10), 34: 504-7(Oct. 16, 1964).

It is suggested that a measurement of the angular distribution and the excitation function for the reaction $K^- + p \rightarrow \Lambda^0 + X^0$ would enable one to determine the spin and parity of the X^0. A reaction mechanism of peripheral collision is considered. As a 0^- or 1^+ meson cannot be produced by the process of one-meson (K)-exchange, the one-K* (888 Mev)-exchange process would play the most important role in the reaction. This model is employed to estimate the differential cross section for the $K^- + p \rightarrow \Lambda^0 + X^0$ reaction at 2.3, 2.7, and 3.8 Bev/c under the assumptions that the X^0 is a 0^- or 1^+ meson and that its isotopic spin is zero. (C.E.S.)

44557 RESONANCE POLES IN THE THREE-PARTICLE SECTOR OF THE LEE MODEL. I. J. R. Aitchison (Centre d'Etudes Nucleaires, Saclay, France). Nuovo Cimento (10), 34: 508-11(Oct. 16, 1964).

The Peierls mechanism for the 1510-Mev π-N resonance is investigated in the Lee model. It is shown that the Vθ elastic amplitude T has a pole, off the real axis, associated with the Peierls mechanism, in the right place to produce a resonance if the various parameters conspire favorably. (C.E.S.)

44558 PARTICLE MASS SPECTRUM AND LEVEL DENSITY. T. Takabayasi (Univ. of Nagoya, Japan). Nuovo Cimento (10), 34: 512-15(Oct. 16, 1964).

It is pointed out as an empirical rule that mesonic levels are populated on the average with a level density increasing in proportionality to mass, based on a simple overall mass formula. From this mass formula some useful mass relations for mesonic states are derived and several semi-quantitative predictions are made. (C.E.S.)

44559 ANOMALOUS THREE-QUANTUM DECAY OF POSITRONS IN ALKALINE EARTH OXIDES. C. Bussolati and L. Zappa (Istituto di Fisica del Politecnico, Milan). Phys. Rev., 136: A657-9(Nov. 2, 1964).

The decay of positrons annihilating in alkaline earth oxides was investigated through lifetime and three- to two-quantum relative yield measurements. It was found that in these materials positrons display an anomalous behavior: the time annihilation spectrum is complex, exhibiting a long-life component, and the abundance of three-quantum events is exceptionally large. The observed abundance exceeds the value that can be calculated assuming positronium formation by a factor up to 15. (auth)

44560 Λ-PROTON SCATTERING AT 120-320 Mev/c. G. Alexander (Weizmann Inst. of Science, Rehovoth, Israel), U. Karshon, A. Shapira, G. Yekutieli, R. Engelmann, H. Filthuth, A. Fridman, and A. Minguzzi-Ranzi. Phys. Rev. Letters, 13: 484-6(Oct. 12, 1964).

The scattering of hyperons(Λ) by protons at 120 to 320 Mev/c was investigated. Total cross sections were obtained and compared with other data and with cross sections evaluated by potential scattering and by the effective-range approximation for pure s-wave scattering. The forward-to-backward ratio for hyperons(Λ) at 220 to 320 Mev/c was calculated to be 2.1 ± 0.8, indicating the presence of waves higher than the s wave at these momenta. The up-down asymmetry of the meson(π) in the hyperon(Λ) decay was determined to be −0.22 ± 0.47. (D.C.W.)

44561 TOTAL CROSS SECTIONS AND ANGULAR DISTRIBUTIONS FOR $\pi^- + p \rightarrow \eta^0 + n$ FROM THRESHOLD TO 1151 Mev. F. Bulos (Brown Univ., Providence), R. E. Lanou, A. E. Pifer, et al. Phys. Rev. Letters, 13: 486-9 (Oct. 12, 1964). (MIT-2098-63)

The angular distributions and cross sections for meson(η^0) production in the interaction $\pi^- + p \rightarrow \eta^0 + n$ were measured at energies from threshold to 1151 Mev. The cross section rises rapidly above threshold, reaching a maximum of 0.98 ± 0.08 mb at 659 Mev and then decreasing slowly to 0.38 ± 0.05 mb at 1151 Mev. The angular distributions are isotropic in the region of the 600-Mev resonance, but show forward peaking at 1003 Mev and above. The observations are consistent with $s_{1/2}$ or $p_{1/2}$ production at threshold with some higher states entering at higher energies, but are inconsistent with pure $p_{3/2}$ or $d_{3/2}$ throughout the energy range studied. (D.C.W.)

44562 SECONDARY DIFFRACTION PEAKS IN πN AND KN SCATTERINGS. A. O. Barut and W. S. Au (Univ. of Colorado, Boulder). Phys. Rev. Letters, 13: 489-91 (Oct. 12, 1964).

It is shown that the secondary peaks observed in π-N and K-N scattering can be explained remarkably well, using even a very small spin-flip amplitude. By using more than one partial wave, even the wiggly structure on the secondary peaks can be explained. (D.C.W.)

44563 PHOTOPRODUCTION OF THE ρ^0 MESON. A. D. Franklin, D. R. Rust, A. Silverman, C. K. Sinclair, and R. M. Talman (Cornell Univ., Ithaca, N. Y.). Phys. Rev. Letters, 13: 491-5(Oct. 12, 1964).

The interaction $\gamma + p \rightarrow p + \rho^0 \rightarrow \pi^+ + \pi^- + p$ was investigated. The mass distribution of the π-π system was measured over a range of masses substantially larger than the meson(ρ^0) width. The angular distribution of the meson(ρ^0) photoproduction was also studied. (D.C.W.)

44564 DO HYPERPHOTONS EXIST? Steven Weinberg (Univ. of California, Berkeley). Phys. Rev. Letters, 13: 495-7(Oct. 12, 1964).

Empirical arguments against the previously suggested existence of hyperphotons are presented. (D.C.W.)

44565 BOOTSTRAP THEORY OF OCTET ENHANCEMENT. R. Dashen and S. Frautschi (California Inst. of Tech., Pasadena). Phys. Rev. Letters, 13: 497-500 (Oct. 12, 1964).

It is shown that the bootstrap mechanism can provide a simple, unified explanation of octet enhancement in strong, electromagnetic, and weak symmetry breaking. A model of octet enhancement for mass splittings of the $J = \frac{1}{2}^+$ B octet and the $J = \frac{3}{2}^+$ Δ decuplet is presented. (D.C.W.)

44566 BROKEN SYMMETRIES AND WEAK INTERACTIONS. [PART] II. Julian Schwinger (Harvard Univ., Cambridge, Mass.). Phys. Rev. Letters, 13: 500-1(Oct. 12, 1964).

A discrepancy in the fractional violation of the SU(3) coupling-constant equality for the SU(3) K- and π-baryon couplings was previously noted in a discussion of pionic hyperon decays. It is shown that inclusion of strong octuplet-singlet mixing improves the situation. (D.C.W.)

44567 INVESTIGATION OF ABSORPTION EFFECTS IN THE REACTION $\pi^- + p \rightarrow \pi^- + \pi^0 + p$ AT 4 Gev/c. I. Derado, V. P. Kenney, and W. D. Shephard (Univ. of Notre Dame, Ind.). Phys. Rev. Letters, 13: 505-7(Oct. 19, 1964).

The results of an analysis of absorptive effects in the interaction $\pi^- + p \rightarrow \pi^- + \pi^0 + p$ at 4 Bev/c are presented. The process $\pi^- + p \rightarrow \rho^- + p$, in which the meson ($\rho^-$) is produced peripherally with a very small cross section, was specifically considered. (D.C.W.)

44568 SPLITTING OF THE 70-PLET OF SU(6). Mirza A. Baqui Bég (Rockefeller Inst., New York) and Virenda Singh. Phys. Rev. Letters, 13: 509-11(Oct. 19, 1964).

An expression previously proposed for the mass operator responsible for lifting the degeneracies of spin-unitary spin supermultiplets is applied to the 70-dimensional representation of SU(6). (D.C.W.)

44569 SU(6) AND ELECTROMAGNETIC INTERACTIONS. M. A. B. Bég (Rockefeller Inst., New York), B. W. Lee, and A. Pais. Phys. Rev. Letters, 13: 514-17 (Oct. 19, 1964).

Some properties of the electromagnetic vertex of baryons are discussed under the assumption that the effective electromagnetic current associated with the strongly interacting particles transforms according to the adjoint representation of the group SU(6). (D.C.W.)

44570 LINEAR AND ANTILINEAR TRANSFORMATIONS OF THE DIRAC WAVE FUNCTION FOR MASSLESS PARTICLES UNDER CONFORMAL CO-ORDINATE TRANSFORMATIONS. N. C. Rastogi (Univ. of Lucknow, India). Proc. Natl. Inst. Sci. India, Pt. A, 29: 520-7(Sept. 26, 1963).

Explicit expressions are given for the transformations of the wave function when a relativistic conformal transformation of the coordinates is made. The possibility of antilinear transformations, which mix the original and the charge-conjugate wave functions, is taken into account. (auth)

44571 RESONANCE SCATTERING THEORY. A. Herzenberg, K. L. Kwok, and F. Mandl (Univ. of Manchester, Eng.). Proc. Phys. Soc. (London), 84: 477-97(Oct. 1964).

A general formalism for the scattering of particles by a complex target is developed. The scattering amplitude is expressed as the sum of the first Born approximation amplitude plus a sum of contributions from resonance terms. The Pauli principle is taken into account. No joining radius, defining an internal region, occurs in the theory since the resonant states are defined as extending over all space with asymptotic outgoing wave boundary conditions. There is no hard sphere scattering term in the scattering amplitude. (auth)

44572 FEASIBLE COMPLETE EXPERIMENTS OF PION PHOTOPRODUCTION. Masaaki Kawaguchi, Hiroo Shimoida, Yoshio Sumi, and Tamotsu Ueda (Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 31: 1026-43(June 1964).

The possibility of measuring the differential cross sections for pion production on nucleons with polarized gamma rays and the polarization of the recoil nucleon is investigated. A formulation is developed for pion photoproduction from deuterons, and polarized target experiments in which deuterons are used are considered. An alternative experiment is proposed in which the effect of the Pauli principle is large. (D.C.W.)

44573 ON THE ISOSPIN STRUCTURE OF THE STRANGE PARTICLE DECAYS. Shin-ya Furui (Ibaraki Univ., Mito, Japan), Joji Iisaka, and Makoto Sawamura. Progr. Theoret. Phys. (Kyoto), 31: 1044-65(June 1964).

The isospin structure of the strangeness changing decays is studied on the basis of phenomenological analysis of $Y_{N\pi}$, $K_{2\pi}$, Y_1, and K_{13} decays, taking into account the $|\Delta I| = \frac{1}{2}$ and $|\Delta I| = \frac{3}{2}$ interactions. For the nonleptonic decays, the validity of the $|\Delta I| = \frac{1}{2}$ rule is examined; and it is found that the $|\Delta I| \neq \frac{1}{2}$ part of the decay amplitudes is

likely to be as large as at most one-tenth of that of $|\Delta I| = \frac{1}{2}$. As for the leptonic decays, it is shown that the $|\Delta I| = \frac{3}{2}$ parts, with $\Delta S/\Delta Q = +1$, as well as $\Delta S/\Delta Q = -1$, are also fairly small in comparison with the $|\Delta I| = \frac{1}{2}$ part. Some restrictions to the theoretical parameters are presented. (auth)

44574 ω MESON AND A BOUND STATE OF ρ-π SYSTEM. Akira Kanazawa and Naoki Tokuda (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 31: 1066-72 (June 1964).

The possibility that the meson(ω), can be understood as a bound state of the ρ-π system, is investigated, assuming that the meson(ρ) is stable. It is shown that the ω-exchanging force alone is not sufficient to produce a bound state in a self-supporting mechanism. However, a bound state is expected if there is an external force which is attractive and stronger than a certain critical value. It is suggested that the ρ-exchanging force is a possible candidate for the external force, and the mass of bound state thus obtained has a lower limit of $\sqrt{m_\rho{}^2 + m_\pi{}^2} \cong 780$ Mev. The coupling constant is estimated to be $g_{\pi\rho\omega}{}^2/4\pi \cong 0.4$, which corresponds to about 10 Mev of the decay width of ω into three pions. The strength of three-ρ coupling, $g_\rho{}^2/4\pi$, becomes about 18, if the ρ-π-π coupling is taken as 2.75. (auth)

44575 INFINITESIMAL SPONTANEOUS MASS SPLITTING. II. SPONTANEOUS SPLITTING AND OCTET SCALAR MESONS. Mahiko Suzuki (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 31: 1073-89(June 1964).

The spontaneous mass splitting is investigated from a general viewpoint for a system governed with a hamiltonian fully symmetric under SU_3 transformations. After a general formulation of the spontaneous splitting, the condition for spontaneous splitting is compared with that of the bound state problem of the baryon-antibaryon using the N/D method. Then, the Gell-Mann-Okubo mass formula requires that an octet scalar meson family should exist with its $T = Y = 0$ member being the lightest. The ABC anomaly and the K-π resonances at $\simeq$ 730 Mev can be tentatively assigned to the $T = Y = 0$ and the $T = \frac{1}{2}$, $|Y| = 1$ members, respectively. The remaining members ($T = 1$, $Y = 0$) are predicted to be around 1350 Mev. It is shown that all the members except the K-π resonances may escape observation and that the inclusion of the meson mass splitting and the spontaneous coupling deviation does not change the results. (D.C.W.)

44576 SPURION IN NONLEPTONIC DECAYS OF STRANGE PARTICLES AND STRONG INTERACTION SYMMETRY. Mahiko Suzuki (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 31: 1090-3(June 1964).

It is shown that the spurion emitted in the nonleptonic decays transforms approximately like a component of the 8-dimensional irreducible tensor of SU_3, due to renormalization effects. The strong interactions are assumed to be fully symmetric under SU_3, apart from small mass differences which make the pole transitions well defined. (auth)

44577 DISPERSION THEORETICAL ANALYSIS OF DEUTERON PROBLEMS. Masao Yamada (Tokyo Univ.). Progr. Theoret. Phys. (Kyoto), 31: 1094-1108(June 1964).

The spin-triplet and isospin-singlet scattering amplitude of two nucleons is analyzed by the usual N/D method. The gap of the left-hand cut is approximated by single π-, ρ-, and ω-meson exchange effects. It is shown that a pole corresponding to the deuteron exists. Using the experimental value for the $^3S_1$ scattering length, the deuteron binding energy E_b, the mixing parameter ρ, and the effective range r_ϵ are calculated from the knowledge of the position and the residue of the pole. The results are $E_b = 1.9 \sim 2.4$ Mev, $\rho = 0.02 \sim 0.06$ and $r_\epsilon = 1.2/\mu \sim 1.3/\mu$, where μ is the meson(π) mass. (auth)

44578 WEAK INTERACTION OF LEPTONS. Seitaro Nakamura (Tokyo Univ. and Nihon Univ., Tokyo) and Yoshio Nishiyama. Progr. Theoret. Phys. (Kyoto), 31: 1109-26(June 1964).

By introducing a strange neutrino besides the electron and meson(μ) neutrinos as well as two kinds of intermediate bosons (isotriplet W and isodoublet B) with masses m_W and m_B ($= \sqrt{5}\, m_W$), a scheme consistent with the existing experimental data for the weak interactions of leptons is constructed. The primary weak interactions are assumed to be interactions between baryonic and leptonic currents and the intermediate bosons; they are of charge-independent form. Effective hamiltonians for the leptonic weak interactions of mesons(π) and (K) are constructed, also of charge-independent form. The symmetry between leptons and baryons in the coordinate space can not be attained in the scheme. (auth)

44579 A REMARK ON THE SYMMETRY APPROACHES TO STRONG AND WEAK INTERACTIONS. Jugoro Iizuka and Yoneji Miyamoto (Tokyo Univ. of Education). Progr. Theoret. Phys. (Kyoto), 31: 1127-37(June 1964).

The consistency of the unified approaches with higher symmetry to strong and weak interactions is investigated in the symmetry limit, taking the SU(3) model with RP invariance as an example. The origin of weak interaction or the relative importance of weak and symmetry-breaking interactions, particularly, are considered. Consistency of the theory in the absence of symmetry-breaking interactions requires that the weak hamiltonian of the conventional form (current-current type or current-time intermediate boson) must be modified to include the bare two-body weak interactions in such a way that none (or none except the unitary singlet) of the transitions appear in the theory. The two-body transitions are connected with a pair of fields belonging to the same mass-multiplets of SU(3). The pole approximations in the nonleptonic decays of hyperons are discussed from the viewpoints of both the conventional and modified schemes. (D.C.W.)

44580 INTERMEDIARY BOSON EFFECTS IN RADIATIVE MUON CAPTURE. Akira Toyoda (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), 31: 1155-7(June 1964).

The effect of an intermediate vector meson on radiative meson(μ) capture is investigated. (D.C.W.)

44581 PHENOMENOLOGICAL α-α POTENTIAL. Osamu Endō, Ichirō Shimodaya, and Jun Hiura (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 31: 1157-8(June 1964).

The features of the alpha-alpha interaction were investigated, together with the extent to which alpha-alpha scattering can be explained in terms of an energy-independent potential. (D.C.W.)

44582 COMMENTS ON THE MASS FORMULA FOR MESON-BARYON SYSTEM. Shuzo Ogawa (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 31: 1159-60(June 1964).

The original mass formula based on the Sakata model is modified to serve Maki's model in which four UR-baryons combine to form the octet baryon system. Okubo's mass formula is rewritten in a form that reveals its contributions. (D.C.W.)

44583 p-p PHASE SHIFTS AT 970 Mev. Yogiro Hama and Norio Hoshizaki (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 31: 1162-3(June 1964).

An unsuccessful attempt was made to discriminate be-

tween two phase-shift solutions (corresponding to peripheral and nonperipheral absorption types) obtained previously for p-p interaction at 970 Mev, using recent data on Coulomb interference effects at 970 Mev. (D.C.W.)

44584 CABIBBO THEORY AND THE MESON CLOUD. Mineo Fukawa (Tokyo Univ. of Education). Progr. Theoret. Phys. (Kyoto), 31: 1165-7(June 1964).

The Cabibbo theory for leptonic decay between the hadrons of the eight-dimensional representation is considered. A relation between the effective weak current and the meson cloud is derived, assuming that in the Cabibbo current the effect of the meson cloud is taken into account so well that the form of the current does not change, even after the radiative correction for the meson current. (D.C.W.)

44585 INTERNAL STRUCTURE AND SYMMETRY OF ELEMENTARY PARTICLES. [PART] I. Hideki Yukawa (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 31: 1167-9 (June 1964).

An internal symmetry of elementary particles which may be identified with the symmetry in the isospin space is suggested. (D.C.W.)

44586 VALIDITY OF GELL-MAN-OKUBO'S MASS FORMULA FOR S-WAVE UNITARY MULTIPLET. Fujio Takagi (Tohoku Univ., Sendai). Progr. Theoret. Phys. (Kyoto), 31: 1169-70(June 1964).

It is shown that the motion of the S-wave pole is quite complicated in relation to those of higher wave poles, when they pass through the lowest threshold. This indicates that Gell-Mann-Okubo's mass formula is not as valid for S-wave unitary multiplets, if they exist, as for the higher wave multiplets. The possible existence of an S-wave unitary octet in meson-baryon scattering is suggested. (D.C.W.)

44587 BROKEN U(4)-SYMMETRY IN BARYON-MESON SYSTEM. Mitsuru Hama (Osaka Univ.), Ken-iti Matumoto, and Sho Tanaka. Progr. Theoret. Phys. (Kyoto), 31: 1171-2 (June 1964).

A broken U(4) symmetry is proposed for the baryon-meson system. (D.C.W.)

44588 REMARKS ON PION-PION RESONANCE. Susumu Furuichi (Rikkyo Univ., Tokyo), Hiroyuki Kanada, and Keiji Watanabe. Progr. Theoret. Phys. (Kyoto), 31: 1172-4(June 1964).

The possibility of obtaining the mass and width of the meson (ρ) by the N/D method was investigated. P-wave π-π scattering was considered, neglecting inelastic processes. (D.C.W.)

44589 ON STABILITY OF SYMMETRY-BREAKING SOLUTIONS. Daisuke Itô and Yasuyuki Kurata (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 31: 1174-6(June 1964).

The stability condition for symmetry-breaking solutions for interacting massless (bare) particles is investigated by calculating the vacuum energies in the one-particle theory. (D.C.W.)

44590 REMARKS ON MASS SPECTRUM OF DECUPLET BARYONS. [PART] 1. Takehiko Takabayasi (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), 31: 1178-80(June 1964).

The SU_3 mass relations for the decuplet as well as the octet baryon states are discussed. (D.C.W.)

44591 REMARKS ON MASS SPECTRUM OF DECUPLET BARYONS. [PART] II. Takehiko Takabayasi (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), 31: 1180-1 (June 1964).

The mass relations of the preceding article are compared with some experimental data. A formula for the mass relation between the decuplet and octet baryons is also presented. (D.C.W.)

44592 ON THE POSSIBLE HYPERON RESONANCE Y_0^{1*} (2120). Chong-shou Gao (Peking Univ.). Sci. Sinica (Peking), 13: 1501-2(Sept. 1964).

Results of K^- + p and π^- + p experiments are reviewed, indicating the possible existence of a hyperon resonance Y_0^{1*} with a mass near 2120 Mev. The properties of the resonance are discussed on theoretical bases. (D.C.W.)

44593 φ-ω MIXING AND THE REDUCIBLE REPRESENTATION OF THE SU_3 GROUP. Chong-shou Gao (Peking Univ.). Sci. Sinica (Peking), 13: 1503-6(Sept. 1964).

The partial widths $\Gamma(\varphi \rightarrow K\bar{K})$ and $\Gamma(\varphi \rightarrow \rho\pi)$, their sum, and their ratio $\Gamma(\varphi \rightarrow \rho\pi)/\Gamma(\varphi \rightarrow K\bar{K})$ were calculated, assuming that the operators of the unitary octet and the unitary singlet are always described uniformly by a 3×3 matrix M^* and that the trace M^* should not appear in the interaction Lagrangian with SU(3) invariance. The results are compatible with experiment. (D.C.W.)

44594 THE DECAY OF HEAVY HYPERNUCLEI. J. P. Lagnaux (Universite Libre, Brussels), J. Lemonne, J. Sacton, et al. Univ. Bruxelles, Inst. Phys., Bull. No. 13, 19p. (June 1964).

In a sample of 38,238 interactions found in photographic emulsions exposed to K^- mesons of momenta 1.3 and 1.5 Bev/c, a total of 1385 heavy hypernuclei ($40 < A < 100$) was observed, of which 11 decayed mesonically. The following results were obtained: an upper limit of (27 ± 3) Mev for the Λ^0 nuclear potential-well depth, a nonmesonic/mesonic decay ratio in the range 100 to 200 and a fraction in the range 0.6 to 0.9 of non-mesonic decays stimulated by the weak Λ^0–neutron interaction. (auth)

44595 SOME EMPIRICAL FORMULAS FOR MASSES OF π-π RESONANCES WITH EVEN ISOSPINS. Chong-shou Gao. Wu Li Hsueh Pao, 20: 680-1(July 1964). (In Chinese)

44596 THE CORRECTION OF VELOCITY-DEPENDENT POTENTIAL TO THE MAGNETIC MOMENT OF DEUTERON. Chi-ming Chu. Wu Li Hsueh Pao, 20: 682-4 (July 1964). (In Chinese)

44597 THE TRANSFORMATION GROUP OF SCATTERING MATRIX LEAVING ANGULAR DISTRIBUTION INVARIANT. Pei-yu Hou. Wu Li Hsueh Pao, 20: 691-5(July 1964). (In Chinese)

44598 RESONANCES NEAR THRESHOLDS AND SU3 SYMMETRY. Hans A. Weidenmueller (Universität, Heidelberg). Z. Physik, 180: 425-9(1964).

A problem raised recently by Oakes and Yang is discussed within the framework of a nonrelativistic model. Arguments are presented for the purity of the wave functions of the decuplet. The accuracy of the mass formula is discussed in terms of the widths of the resonances. A criterion is given for the applicability of the SU3 model to the calculation of cross sections and branching ratios. (auth)

44599 THE PION-NUCLEON FORWARD SCATTERING AMPLITUDE. G. Hoehler, G. Ebel, and J. Giesecke (Technische Hochschule, Karlsruhe, Ger.). Z. Physik, 180: 430-48(1964).

The pion-nucleon forward scattering amplitude was calculated from new data of the total cross sections, using several assumptions on the energy dependence above 20 Bev. The results are presented as complex diagrams of the forward amplitude, which are of interest for the dis-

cussion of the nucleonic resonances and the nonresonant background scattering. In addition, the predictions for the elastic forward cross sections are given as well as the contributions of the real parts to this quantity. A comparison with the new Saclay data of the charge exchange forward cross section leads to the estimate $\alpha_P(0) \approx 0.6$, if a Regge behavior is assumed above 20 Bev. There are indications in favor of a new $T = \frac{1}{2}$ resonance at the total c.m. energy $W \approx 2.8$ Bev. (auth)

Field Theory and Quantum Mechanics

44600 (ISS-64/22) EXPERIMENTAL SEARCH FOR A POSSIBLE CHANGE OF THE β DECAY CONSTANT WITH CENTRIFUGAL FORCE. M. Ageno and E. Amaldi (Italy. Istituto Superiore di Sanità, Rome). June 14, 1964. 48p.

An experiment aimed at establishing a possible change in the β decay rate due to high centrifugal forces is described, and the results are presented and discussed. The experiments performed by other researchers along similar lines are also summarized and reviewed, and a few critical remarks are added. A circular ionization chamber was used to measure decay rates for radius needles under centrifugation. (R.E.U.)

44601 (MIT-2098-55) VACUUM POLARIZATION. K. Johnson, M. Baker, R. Willey, and H. Mitter (Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science). [July 7, 1964]. Contract AT(30-1)-2098. 8p.

The behavior of the vacuum polarization integral in the Green's functions of quantum electrodynamics is discussed. (R.E.U.)

44602 (NP-14379) A HAMILTONIAN FORMALISM WITH A LINEAR SUPPLEMENTARY CONDITION AND ITS APPLICATION TO FIELD THEORY AND MANY-BODY SYSTEM. Yasushi Takahashi (Dublin Inst. for Advanced Studies). [1963]. 26p.

A hamiltonian method with a linear supplementary condition is proposed, and is applied to a many-particle system in order to see how the independent-particle model can be justified. A particle interacting with a field is also dealt with in terms of this formalism. The formalism is found to be useful to treat systems of many degrees of freedom without destroying the symmetry and the translation invariance. (auth)

44603 (UCRL-11566) THE HILBERT SPACE FUNCTIONAL ANALYSIS OF SCATTERING THEORY (thesis). Michael Scadron (California. Univ., Berkeley. Lawrence Radiation Lab.). May 22, 1964. Contract W-7405-eng-48. 113p.

The Hilbert space functional analysis of "L^2" states and operators is applied in detail to the full and partial wave amplitudes of potential theory. Fredholm, Born, eigenfunction, and quasiborn expansions of the amplitude are treated, and variational techniques are used. A complete proof of all analytic and asymptotic properties of potential theory amplitudes is given, including the large angular momentum behavior of the partial wave amplitude. The method is extended to relativistic Bethe-Salpeter scattering and contrasted with the Banach space functional analysis of Hunziker. 52 references. (auth)

44604 THEORY OF SPINORS OF THE GROUP $\hat{c} \times \hat{c}'$ PHYSICAL INTERPRETATION OF THE GROUPS $\hat{c}$ and $\hat{c}'$. Jan Mozrzymas (Inst. of Physics, Wroclaw, Poland). Acta Phys. Polon., 25: 819-24(June 1964).

The theory of $\hat{c} \times \hat{c}'$-spinors is given. This spinor theory is based on the curved complex space C_4 in a similar manner as the spinor calculus in general relativity is based on Riemannian space. The physical interpretation of the group $\hat{c} \times \hat{c}'$, is briefly discussed and the connection between the $\hat{c} \times \hat{c}'$-spinors and C_4-vectors is established. The $\hat{c} \times \hat{c}'$-spinor theory is considered as the geometrical basis for the theory of interactions of elementary particles. (auth)

44605 ON THE CONSTRUCTION OF INVARIANTS FOR SU(n). L. Egardt (Uppsala Univ.). Arkiv Fysik, 27: 193-4 (1964).

Biedenharn (J. Math. Phys., 4: 436(1963)) has given an explicit solution to the problem of constructing a complete set of independent invariants for the unimodular unitary group in n dimensions, SU(n). The essential idea behind such a program is to create a basis for an extension of the Wigner-Racah angular momentum calculus and in particular to determine the irreducible representations in a form suitable for physical application. Biedenharn regards the construction of the Casimir invariant as furnishing a prescription for obtaining an invariant (given two vector operators) defined in terms of the commutation relations with respect to the elements of the infinitesimal ring of SU(n). A general procedure then suggests itself, namely the construction of a third vector operator by vector-coupling the two given ones. The suitable method for solution of this problem is to utilize the symmetric coupling coefficients defined by the anticommutator of the generators. A simple proof is given that these coefficients determine a vector operator. (auth)

44606 PERTURBATION OF RESONANCE STATES BY A CENTRAL POTENTIAL. G. Lebon (Université, Liège). Bull. Soc. Roy. Sci. Liege, 33: 324-36(1964). (In French)

The general solution of the perturbation problem of resonant states is given to the first order for a spherically symmetric potential. In the particular case of the perturbation of a critical potential, higher orders are given, and a square-well potential is considered as an example. (auth)

44607 THE ENERGY-MOMENTUM TENSOR OF A STATIC GRAVITATIONAL FIELD. J. Horský (Universität, Brno). Czech. J. Phys., 14: 565-9(1964).

The method of a tetrad field was used to determine the energy-momentum tensor for an approximate solution of the Einstein equations in the static case, from which it follows that the static gravitational field has non-zero mass but zero momentum, as expected. (auth)

44608 ASYMPTOTIC EXPANSION OF SINGULAR SOLUTIONS FOR SPINOR FIELD THEORY. L. E. Lebedev (Dnepropetrovsk State Univ., USSR). Izv. Vysshikh Uchebn. Zavedenii, Fiz., No. 4, 41-6(1964). (In Russian)

A binary series method was used for constructing (at fixed ϑ) an asymptotic expansion of singular spins for the case of strong pseudovector self-action. The quantum state asymptotics were separated, and the vector effect on the self-action was observed. Asymptotics of bound stationary states are analyzed. (tr-auth)

44609 ON RADIATION FRICTION OF A CHARGE MOVING IN PERIODICALLY INHOMOGENEOUS MEDIUM. V. V. Tamoikin (Gor'kii Univ., USSR). Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 7: 432-41(1964). (In Russian)

The radiation of electromagnetic waves was considered for a charged particle moving in a medium with periodically varying properties. The charge is assumed to perform both translational motion and oscillations. It is shown that in some cases even in a weakly inhomogeneous me-

dium the resonance between oscillations and the field of transient radiation must be taken into account. This resonance leads to oscillations. Expressions were obtained for radiated electromagnetic energy for the medium with large-scale and small-scale inhomogeneities. (auth)

44610 RADIATION PRINCIPLE IN ELECTRODYNAMICS OF MOVING MEDIA. B. M. Bolotovskii and S. N. Stolyarov (Lebedev Inst. of Physics, Moscow). Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 7: 442-5 (1964). (In Russian)

In solving the electrodynamic equations, the question of a single-valued choice of the retarded solutions arises. If only the Fourier components of the solutions are found, the equivalent question of circumventing the poles meeting on the path of integration arises. It was shown previously that the retarded solution of the field equations in a stationary medium and its first derivative go to zero for $t = -\infty$. Here, it is shown what form the solution takes to satisfy this requirement for the case of a moving medium. Expressions for the 4-potential and for the energy loss by Vavilov-Cherenkov radiation in a moving medium are obtained. (M.J.T.)

44611 LORENTZ INVARIANT MULTICHANNEL SCATTERING FORMALISM. Thomas F. Jordan (Universität, Bern). J. Math. Phys. (N. Y.), 5: 1345-60(Oct. 1964).

A manifestly Lorentz invariant hamiltonian formalism for multichannel scattering and production processes is developed by making two simple and natural extensions of the ordinary quantum mechanical formalism. The first is the asymptotic covariance postulate of Fong and Sucher, which is essentially a necessary and sufficient condition for Lorentz invariance of the scattering amplitudes. The second is a Lorentz invariant extension of the asymptotic condition. It is shown that the latter is in fact no extension at all in a case in which the total momentum operators of the asymptotic (unperturbed) systems are the same as the total momentum operators of the interacting system. In such a case the ordinary multichannel scattering formalism is completely Lorentz invariant whenever asymptotic covariance is satisfied. (auth)

44612 THE CONCEPT OF NONLOCALIZABLE FIELDS AND ITS CONNECTION WITH NONRENORMALIZABLE FIELD THEORIES. B. Schroer (Inst. for Advanced Study, Princeton, N. Y.). J. Math. Phys. (N. Y.), 5: 1361-7(Oct. 1964).

From an investigation of the two-point function in nonrenormalizable field theories, it is shown that at least in certain approximations, a nonrenormalizable field is nonlocalizable. This is intimately connected with the occurrence of essential singularities on the light cone in the Wightman functions of the field. Green's functions cannot be defined; and the observables, in particular the scattering matrix elements, have to be expressed directly in terms of the unordered expectations values. (auth)

44613 THE GRAVITON AS A SPIN-2 PARTICLE. Olof Brulin and Stig Hjalmars (Royal Inst. of Tech., Stockholm). J. Math. Phys. (N. Y.), 5: 1368-70(Oct. 1964).

It is proved that the linearized gravitational field can be described by a first-order relativistic wave equation with matrix coefficients, obtained in a simple way from the generators of the full linear group in five dimensions. (auth)

44614 REMARKS ON THE POLYNOMIAL BOUNDEDNESS IN THE MANDELSTAM REPRESENTATION. Y. S. Jin and A. Martin (Inst. for Advanced Study, Princeton, N. J.). J. Math. Phys. (N. Y.), 5: 1406-12(Oct. 1964).

The Mandelstam representation is a statement about the region of analyticity and asymptotic behavior (polynomial boundedness) of a scattering amplitude. In virtue of the unitarity condition, however, these two are not completely independent. Some physical consequences — uniqueness, polynomial boundedness of the total cross section, etc. — which have been already derived from the Mandelstam representation are shown to be preserved, even if the polynomial boundedness is replaced by a somewhat weaker assumption. By making use of unitarity, analyticity, and crossing symmetry, the following type of scattering amplitude $F = E + M$, where E is an entire function in both complex variables s and t, while M denotes a Mandelstam-type function with finite number of subtraction, is shown to be ruled out. Similarly, $F = EM$ is also ruled out, if the additional restriction is imposed that E should increase less fast than an exponential in one variable while the other is finite. (auth)

44615 AN ITERATIVE SOLUTION OF THE N/D EQUATION. Myron Bander (Stanford Univ., Calif.). J. Math. Phys. (N. Y.), 5: 1427-30(Oct. 1964). (SLAC-PUB-31)

An iterative scheme is presented for solving the N/D equations for the case in which the left-hand cut consists entirely of a sum of poles. At no step is recourse to a matrix inversion of an algebraic system required. A scheme for approximating arbitrary cuts by sequences of poles is also presented. (auth)

44616 DUALITY INVARIANCE AND RIEMANNIAN GEOMETRY. R. Penney (Ford Motor Co., Dearborn, Mich.). J. Math. Phys. (N. Y.), 5: 1431-7(Oct. 1964).

It is shown that the postulate of indistinguishability of the Maxwell field tensor from its dual leads to the concept of the electromagnetic field tensor as a spinor component in dual space. The demand for algebraic consistency dictates a unique connection with the gravitational field. The Maxwell field must be viewed as a set of potentials, and the necessity for a duality gauge condition excludes the existence of magnetic monopoles. (auth)

44617 REPRESENTATIONS OF THE INHOMOGENEOUS LORENTZ GROUP IN TERMS OF AN ANGULAR MOMENTUM BASIS: DERIVATION FOR THE CASES OF NONZERO MASS AND ZERO MASS, DISCRETE SPIN. J. S. Lomont (Polytechnic Inst. of Brooklyn) and H. E. Moses. J. Math. Phys. (N. Y.), 5: 1438-57(Oct. 1964).

It was previously shown that the infinitesimal generators of the proper, orthochronous, inhomogeneous Lorentz group act in a basis in which the square of the angular momentum, the z component of the angular momentum, the helicity and the energy are diagonal for the irreducible representations which correspond to the cases of nonzero and zero mass and discrete spin. The basis is derived from the commutation rules for the infinitesimal generators and the form of the representations given in the components of the momentum are diagonal. (auth)

44618 FUNDAMENTAL PROPERTIES OF PERTURBATION-THEORETICAL INTEGRAL REPRESENTATIONS. PART III. Noboru Nakanishi (Brookhaven National Lab., Upton, N. Y.). J. Math. Phys. (N. Y.), 5: 1458-73(Oct. 1964). (BNL-7834)

The asymptotic behavior and subtraction problem of the perturbation-theoretical integral representation (PTIR) are investigated in detail. Six theorems are rigorously proved in this connection. It is shown that a function represented by an unsubtracted PTIR may asymptotically increase in particular directions. The relation between the asymptotic behavior and the subtraction number is clarified for the

subtracted PTIR. As a by-product a consistent definition of a finite part of the integral involving $x^{-1}\theta(x)$ is obtained. (auth)

44619 A VARIATIONAL SOLUTION OF THE TIME-DEPENDENT SCHROEDINGER EQUATION. A. D. McLachlan (Cambridge Univ., Eng.). Mol. Phys., 8: 39-44 (1964).

A variational method is described for finding approximate solutions of the time-dependent Schroedinger equation. It is closely related to Frenkel's, but better in some respects because it always leads to a true minimum of the error. For several interacting systems it leads to the time-dependent Hartree equations; for a system in an oscillating electric or magnetic field it gives a variational principle for calculating the susceptibility at any frequency. (auth)

44620 MASSLESS FERMIONS IN TWO-DIMENSIONAL ELECTRODYNAMICS. Egon Marx and Igor Saavedra (Universidad de Chile, Santiago). Nucl. Phys., 60: 337-42(Nov. 1964).

The connection between a result obtained by Schwinger concerning the mass of the vector field in a two-dimensional model of electrodynamics and the condition of masslessness of the charged fermion field is discussed in a perturbational approach. (auth)

44621 CONSTRUCTION OF INVARIANTS FOR SIMPLE LIE GROUPS. M. Micu (Inst. for Atomic Physics, Bucharest). Nucl. Phys., 60: 353-62(Dec. 1964).

A coupling coefficient for the orthogonal and symplectic groups is defined. It can be utilized to construct a set of invariants, and it is proved that these are all the independent invariants of the considered groups, expecting the orthogonal group in even dimensions, for which an invariant cannot be constructed in a similar way. For the unitary unimodular group a corresponding coupling coefficient is given. (auth)

44622 A COVARIANT MULTIPOLE FORMALISM FOR EXTENDED TEST BODIES IN GENERAL RELATIVITY. W. G. Dixon (Cambridge Univ., Eng.). Nuovo Cimento (10), 34: 317-39(Oct. 16, 1964).

A discussion and criticism is given of various forms that were put forward for the multipole theory of an extended test body in curved space-time, and a new treatment is proposed, in which the effect of an electromagnetic field is included and in which manifest covariance is retained throughout by the use of bitensors. Included in this is a covariant definition of the world-line of the mass center. Equations of motion are derived in the pole-dipole approximation, and a comparison is made with the previous theories. It is seen that, although the new theory avoids the defects mentioned in the former theories, solutions of the equations satisfy those of the former theories if terms quadratic in the spin are neglected. (auth)

44623 COMMUTATION RELATIONS FOR ENERGY-MOMENTUM TENSOR. A. Peres (Israel Inst. of Tech., Haifa). Nuovo Cimento (10), 34: 340-2(Oct. 16, 1964).

It is shown that Schwinger's formula for $[T^{00}(x), T^{00}(y)]$ cannot be generalized, in a covariant fashion, to the other components of the energy-momentum tensor. (auth)

44624 CONSTANCY OF $e^2/\hbar c$ IN A GRAVITATIONAL FIELD. A. Peres (Israel Inst. of Tech., Haifa). Nuovo Cimento (10), 34: 343-5(Oct. 16, 1964).

It is shown that if the fine structure constant depends on the gravitational potential V as $(1 + kV/c^2)$, then the experimental limit on k is $|k| < 10^{-9}$. Similar results hold for the proton/electron mass ratio and many other dimensionless physical constants. (auth)

44625 COMMUTATION RELATIONS FOR ELECTROMAGNETIC POTENTIALS. A. Peres (Israel Inst. of Tech., Haifa). Nuovo Cimento (10), 34: 346-50(Oct. 16, 1964).

From the known (gauge-independent) value of $[F_{\alpha\beta}(x), F_{\gamma\delta}(y)]$, the most general expression for the commutator $[A_\alpha(x), A_\beta(y)]$ is derived. The latter contains four arbitrary functions $N_\alpha(x,y)$, which, if suitably chosen, may yield the Coulomb gauge, the Feynman gauge, the Landau gauge, etc. It is however impossible to go over from one value of $N_\alpha(x,y)$ to another by means of an operator gauge transformation, unless the difference between both values of N_α satisfies some differential relations. (auth)

44626 HIGH-ENERGY BEHAVIOR OF FEYNMAN INTEGRALS INVOLVING SINGULAR CONFIGURATIONS. M. M. Menke (Cambridge Univ., Eng.). Nuovo Cimento (10), 34: 351-70(Oct.16, 1964).

The high-energy asymptotic behavior of Feynman diagrams containing certain singular configurations is investigated. The leading contributions are factorized and summed to give Regge-pole terms. A new feature of the discussion is that it is sometimes necessary to scale disconnected sets of lines in addition to the usual connected sets. (auth)

44627 LAGRANGIAN THEORY FOR NEUTRAL MASSIVE SPIN-2 FIELDS. R. J. Rivers (Imperial Coll. of Science and Tech., London). Nuovo Cimento (10), 34: 386-403(Oct. 16, 1964).

Using second-rank tensor field variables $\varphi^{\mu\nu}$ and requiring that the theory be derivable from a lagrangian variational principle (and consequentially can be quantized), it is shown that the theory is restricted to the case in which the field variables are taken to be symmetric a priori, and in which the field equations, commutators, propagators, and energy-momentum tensor are uniquely determined, although all derived from a single-parameter family of lagrangians. Conventional normalization of the field variable suggests that the propagators currently used in meson(f^0) theory be halved. It is not possible, as it is in the massive spin-1 case, to determine the lagrangian uniquely by postulating conventional canonical commutation relations, although the requirement of maximum simplicity in these relations does give a preferred lagrangian. (auth)

44628 EXTREME-RELATIVISTIC TRANSFORMATIONS OF RELATIVISTIC WAVE EQUATIONS. A. Sankaranarayanan (Ames. Lab., Ames, Iowa). Nuovo Cimento (10), 34: 436-41(Oct. 16, 1964). (IS-881)

A new method of derivation of the extreme-relativistic transformations of the Dirac and Sakata-Taketani (S.T.) equations is given. The feasibility of using the extreme-relativistic transformation of the S.T. equation for particle interpretation is briefly considered. (auth)

44629 CONNECTION BETWEEN GARRIDO-PASCUAL AND LORENTZ TRANSFORMATIONS. Z. Sankaranarayanan (Ames Lab., Ames, Iowa). Nuovo Cimento (10), 34: 442-9(Oct. 16, 1964). (TID-20591)

It is shown that the Garrido-Pascual transformation and the Lorentz transformation from the laboratory to the rest system of the Kemmer equation are closely connected. The connection is established by restricting the discussion to the physical states. The extreme-relativistic transformation suggested for the Kemmer equation follows as a special case of this correspondence. (auth)

44630 BROKEN SYMMETRIES AND THE MASSES OF GAUGE BOSONS. Peter W. Higgs (Univ. of Edinburgh). Phys. Rev. Letters, 13: 508-9(Oct. 19, 1964).

It was previously shown that the Goldstone theorem (Lorentz-covariant field theories, in which spontaneous breakdown of symmetry under an internal Lie group occurs, contain zero-mass particles) fails if, and only if, the conserved currents associated with the internal group are coupled to gauge fields. It is now shown that, as a result of this coupling, the spin-one quanta of some of the gauge fields acquire mass; the longitudinal degrees of freedom of these particles go over into the Goldstone bosons when the coupling tends to zero. (D.C.W.)

44631 ELECTROMAGNETIC FIELD OF A CHARGED PARTICLE IN UNIFORMLY ACCELERATED MOTION. Vachaspati and Sudarshan L. Punhani (Univ. of Lucknow, India). Proc. Natl. Inst. Sci. India, Pt. A, 29: 501-19 (Sept. 26, 1963).

A uniformly accelerated charged particle is peculiar in that it gives rise, at any given space-time point, either to a retarded or to an advanced electromagnetic field, but not to both. On general grounds, one expects both kinds of fields to exist at all space-time points. The mathematical reason why only one kind of field exists in the case of uniform acceleration is pointed out and a limiting procedure is introduced to overcome the difficulty. It is then possible to obtain both kinds of fields at all points excepting the boundaries of some regions. The field at these boundaries can be determined by requiring that it should eliminate the presence of any unphysical charges. The solutions at these boundaries are not unique. Explicit expressions for the potentials and the fields are given. (auth)

44632 EINSTEIN'S CONNECTIONS. III. DEGENERATE CASES OF THE FIRST CLASS. K. B. Lal (Univ. of Gorakhpur, India). Proc. Natl. Inst. Sci. India, Pt. A, 29: 535-51(Sept. 26, 1963).

The solution of Einstein's first set of equations of the unified field theory has been previously studied in full detail in holonomic and non-holonomic forms for the degenerate cases $g = 0$ and $a^2 - 4kb^2 = 0$ of the first class when $D \neq 0$, for the indices of inertia 0, 2, and 4, and conditions for the existence of at least one solution in each case have been stated. Solutions have also been found in holonomic form for the index of inertia 2, which will remain similar in form for the indices of inertia 0 and 4 also. But this solution contains D as a factor in the denominator of some of its terms, and hence fails for the case when $D = 0$. The solutions of the said equation in holonomic form are here given for the degenerate cases $K + 1 = 0$ and $3K - 1 = 0$ of the first class when $D = 0$, for the index of inertia 0 of $h_{\lambda\mu}$ (in which case only $K + 1$ can be zero), and for the index of inertia 0 and 4 of $h_{\lambda\mu}$ (in which case only $3K - 1$ can be zero). Conditions are stated for the existence of at least one solution in each case. (auth)

44633 SOME EXACT NON-STATIC CYLINDRICALLY SYMMETRIC ELECTROVAC UNIVERSES. L. Radhakrishna (Banaras Hindu Univ., India). Proc. Natl. Inst. Sci. India, Pt. A, 29: 588-95(Sept. 26, 1963).

A non-static cylindrically symmetric metric of Marder is considered and some exact non-static solutions of the Einstein-Maxwell field equations in vacuo are obtained. These solutions include as particular cases uniform electromagnetic fields, which are transforms of "homogeneous" electric or magnetic fields. (auth)

44634 EXTENDED ADIABATIC INVARIANCE. L. M. Garrido (Universidad, Barcelona). Progr. Theoret. Phys. (Kyoto), 31: 969-76(June 1964).

The concept of extended adiabatic invariance is presented. It is shown that a kind of adiabatic invariance holds between the initial and the final eigenstates of a Hamiltonian that initially and finally has a sufficiently slow, explicit time dependence, even though for the intermediate periods of time it may have an arbitrary, rapid or slow, explicit time dependence. (auth)

44635 QUANTUM THEORY OF FIELDS IN AN EXPANDING SPACE. [PART] I. Hidekazu Nariai and Toshiei Kimura (Hiroshima Univ.). Progr. Theoret. Phys. (Kyoto), 31: 1138-52(June 1964).

Procedures are presented for joining the metric for an expanding space with those of flat space-times, and a time-variable is introduced, which is continuous over the whole region defined by the joined metrics. Quantization of the physical component of the vector potential and the original vector potential revealed that in the former case a peculiar feature appears in the four-dimensional commutation function, which serves to destroy the microscopic causality based on a particle image. It is concluded that quantization of the electromagnetic field should be performed in terms of the original vector potential. (D.C.W.)

44636 DEFINITION OF NORMAL PRODUCT AND WICK'S THEOREM IN STATISTICAL MECHANICS. Masanao Kitamura (International Christian Univ., Tokyo). Progr. Theoret. Phys. (Kyoto), 31: 1160-2(June 1964).

A proof that it is possible to define normal products such that the statistical average of any normal product vanishes in the limit of infinite volume is presented, in which normal products are defined in terms of particle operators that satisfy the ordinary commutation relations for fermions or bosons. (D.C.W.)

44637 HEAT FLOW IN A SYSTEM OF COUPLED HARMONIC OSCILLATORS. Éi Iti Takizawa and Keiko Kobayashi (Nagoya Univ., Japan). Progr. Theoret. Phys. (Kyoto), 31: 1176-8(June 1964).

It is shown that energy flow in a one-dimensional lattice system is treated more simply by Schroedinger coordinates than by means of the dynamical solutions expanded in the trigonometric eigenfunctions. The correlation matrix elements are readily calculated. Expressions are obtained showing that the correlation between the velocity and relative displacement of the particles never vanishes asymptotically. (D.C.W.)

44638 THE ANALYTICITY IN THE COMPLEX ANGULAR MOMENTUM VARIABLE ON THE S-MATRIX ELEMENT FOR A NONLOCAL POTENTIAL. Yuan-ben Dai. Sci. Sinica (Peking), 13: 1496-1500(Sept. 1964).

The s-matrix element $s(\lambda,k)$ is proved to be analytic in the right half λ-plane for a nonlocal potential. (D.C.W.)

44639 QUANTUM THEORY OF TRANSPORT PROCESSES IN MAGNETIC FIELDS. [PART] I. J. Hajdu (Universität, Göttingen, Ger.). Z. Physik, 181: 87-95(1964). (In German)

A system of free electrons and fixed scatterers with spatially varying temperature and chemical potential in the presence of electric and magnetic fields is considered. Starting from the quantum-mechanical Liouville equation a simple derivation of the Kubo formulas for the transport coefficients is given. Their antisymmetric part has to be completed by the contribution of the local equilibrium density operator, similarly to the case of the steady diffusion considered by Nakajima. Using a damping theoretical expansion a generalized transport equation is obtained which takes account of the action of the external electric field and the gradient of the temperature and the chemical potential during the collisions (interference effect). (auth)

Geophysics

Refer also to abstracts 44480 and 44488.

44640 (AFCRL-64-174) EQUATORIAL LOCI OF THE EARTH'S MAGNETIC FIELD AND COSMIC-RAY PARAMETERS. Environmental Research Papers No. 5. E. J. Chernosky, J. M. Collins, and M. P. Hagan (Air Force Cambridge Research Labs., Laurence G. Hanscom Field, Bedford, Mass.). Feb. 6, 1964. 19p. (AD-601055)

In addition to the magnetic dip and geomagnetic dipole equators, other magnetic field parameters can be used to define other equators. A total intensity minimum and the horizontal intensity maximum mark equators that differ notably from the dip and dipole equators. The locus of points where the orientation of the magnetic field lines is referred to the mean noon altitude of the sun at equinox, rather than to the earth's surface as is ordinarily done, coincides well with the dip equator and the Katz, Meyer, and Simpson aircraft cosmic-ray equator. Other loci referred to the noon sun at solstice indicate the possibility of a seasonal latitudinal change in the cosmic ray equator. This change is in agreement with seasonal changes noted in measurements made on some equatorial crossings. Longitudes of maximum symmetry of the earth's field as determined from relative positions of the equatorial loci are indicated near the Hawaiian and the Philippine Islands. The Capetown anomaly, of interest in radiation belt studies, is clearly shown by the total intensity minimum equator. Positions of the symmetric[1] field equators are determined from the first-order terms of a Fourier analysis of the latitudes of the various equators. A numerical evaluation of the variability and separation of the different equators is also made. (auth)

44641 (AFCRL-64-275) RESEARCH DIRECTED TOWARD THE INVESTIGATION OF SOLAR PHENOMENA. Final Report. Barbara Bell and Donald H. Menzel (Harvard Univ., Cambridge, Mass. Harvard Coll. Observatory). Feb. 1964. Contract AF19(604)-4962. 27p. (AD-600268)

Research is reported on solar-terrestrial correlations, relating geomagnetic disturbance and solar proton (PCA) events to solar features such as the location (north or south of the solar equator) and magnetic class of the flaring sunspot, radio bursts of spectral types II and IV and their properties and the brightness of the green coronal line. Studies of solar prominesces, involving both measurement and classification of observed prominences, and theoretical investigation of their structure and of physical processes important in their formation are described along with studies of the rocket-observed ultraviolet solar spectrum, with special attention to the Lyman-alpha line of H_2 as a major source of opacity over several hundred angstroms. Work on the calculation of theoretical transition probabilities for complex atoms is described and studies of other solar features including the sunspot zone, the positional relation of flares to sunspots, details of the solar fisk in the light of H alpha and activity zones in the emission-line corona are discussed. Miscellaneous theoretical analyses of solar seeing and of the influence of various atmospheric contaminants on the brightness of the daytime sky are also discussed. (auth)

44642 (AWRE-O-39/64) A DERIVATION OF THE ELECTROMAGNETIC RESONANT FREQUENCIES OF THE EARTH-IONOSPHERE CAVITY, BASED ON TRANSMISSION LINE THEORY. J. A. Russell (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Aug. 1964. 18p.

The resonant frequencies of a cavity in which both earth and ionosphere are perfect conductors are derived, and the effect of a limited conductivity of the ionosphere is then considered. (auth)

44643 (SSD-TDR-63-77) SPACE PHYSICS PROGRAM. Semiannual Technical Note, July 1–December 31, 1962. (Aerospace Corp., El Segundo, Calif.). Apr. 30, 1963. Contract AF04(695)-169. 53p. (AD-407110; TDR-169 (3260)TN-1)

A number of experimental techniques were developed and employed in making measurements of the near-earth space environment from Program 162 satellites. These measurements include the identification of the fluxes and energy spectra of trapped protons and electrons in the region of space from 200 to 700 km and provide the first positive identification that the artificial radiation belt was produced from bomb electrons. Radiometric measurements were also made of the earth's background radiance in the near infrared and middle ultraviolet regions of the spectrum. Data are being analyzed to determine the vertical distribution of ozone in the atmosphere, as inferred from measurements of the attenuation of radiation in the middle ultraviolet due to absorption by the oxygen-3 molecule. Airglow experiments were conducted to study the 5577 Å green and the 6300 Å red lines of atomic oxygen. (auth)

44644 (UAG-R-154) HIGH LATITUDE VLF PROPAGATION. Final Report. Howard F. Bates and Paul R. Albee (Alaska. Univ., College. Geophysical Inst.). July 1964. Contract CST-7338. 164p.

The results of a vlf program started in 1961 are presented. One year's data obtained in 1963 using a rubidium vapor oscillator as the College frequency standard forms the major part of the data discussed. The vlf variations, primarily perturbations of the phase of the signal, are divided into two categories: those effects known to have been associated with a particular type of event, and those that occur regularly with no apparent connection to geophysical events of a disturbance nature. The first category contains vlf phase anomalies produced by solar flare x rays, solar flare cosmic rays (these produce the polar cap disturbance, PCD), solar eclipses, and nuclear explosions. Under the second category, the regularly occurring phase anomalies, occurring primarily at night, which are observed at College, are included. Evidence that these variations are the result of phase interference is presented. Using an analysis of the sunrise pattern, it is shown that second-mode energy must normally propagate strongly to 5,000 km and significantly to well over 8,000 km at night. The variations we observed in the vlf phase and amplitude are consistent only with the notion of wave interference. The production mechanism of the phase variations for each propagating mode is still unknown. The phase variations appear to be produced in a relatively small region of the ionosphere; therefore, height changes cannot produce the effects we see. A model is proposed in which appreciable mode conversion or coupling between ordinarily independently propagating waves occurs at some sort of D region disturbance. Such coupling appears to be the mechanism for the production of the sunrise-sunset pattern; in that case mode conversion takes place near the sun line in the D region. It is suggested that gradients similar to those produced by the sun line might be produced by travelling ionospheric disturbances. The interference between waves produced by coupling at such disturbance lines and those normally propagating could easily produce the large phase changes observed. This mechanism does not require widespread changes in the D region height, and is therefore in agreement with observations. Some events do produce

widespread D region height changes so this mechanism is not being suggested to explain all vlf variations. No significant statistical relation between geomagnetic disturbances and vlf phase variations was found. A discussion of the present theories about magnetic disturbances shows that none would be expected if no data selection process is used; the findings are therefore reasonable, in spite of the reports of connections between vlf and geomagnetic effects. Mode interference at great distances greatly complicates the use of vlf signals for ionospheric research purposes. It is concluded that the long-distance vlf method is a good detection system for certain events such as cosmic flares, solar-flare-induced ionospheric disturbances, and high-altitude nuclear explosions. It cannot presently be used to determine quantitatively the properties of the upper atmosphere or of the various D region disturbance phenomena, so, by itself, it is not a good research tool. In conjunction with other methods it is quite useful. 84 references. (auth)

44645 THE IONIZATION NEUTRALIZATION BALANCE IN THE E-LAYER FROM DATA OF THE TOTAL SOLAR ECLIPSE OF 15 FEBRUARY 1961. Kyril B. Serafimov (Inst. of Geophysics, Sofia). Geofis. Pure Appl., 57: 133-42(1964). (In German)

The basic equations for the ionization-neutralization balance in the E layer take in account the influence of the local ionization sources on the disk of the sun, the dynamic ionospheric processes, and the variations in the equivalent recombination coefficient. The method for determining the characteristic quantities of the ionization-recombination balance (q_{0m},q_d,α) were used to measure data from two ionospheric stations located not far from each other, in the period of the solar eclips on 15 February, 1961. The quantity of the recombination coefficient lay between 0.63×10^{-7} sec^{-1} cm^3 and 2.32×10^{-7} sec^{-1} cm^3; the electron production under the action of the ionizing radiation of the homogen disk shows $q_{0m} \approx 1700$ sec^{-1} cm^{-3}. (auth)

44646 THE NATURE OF THE EFFECT OF SOLAR CORPUSCULAR STREAMS ON THE EARTH'S MAGNETOSPHERE. E. I. Mogilevskii (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 807-16 (1963).

The energy aspect of the interaction of a solar corpuscular stream with the earth's magnetosphere is considered. An evaluation shows that even with the total release of its kinetic energy a corpuscular stream can transfer to the magnetosphere only an energy 2 to 3 orders of magnitude less than the mean intensity of the field of D_i variations. variations. It is shown that solar plasma, in flowing around the magnetosphere, does not transfer energy to the latter if the plasma has a uniform magnetic field (or if the field in the stream is equal to zero). Only plasma with its own nonuniform magnetic field is capable of transferring energy over a long period of time to the earth's magnetic field in a quantity sufficient to induce a magnetic storm. Such a condition is satisfied by a model of a solar corpuscular stream with a force-free magnetic field. A semi-quantitative model was devised of the energy transfer from the oncoming magnetic field of a solar stream to the earth's magnetosphere. The nonstationary compression of the geomagnetic field occurs as a result of the supersonic motion of the magnetic piston from the outer boundary of the magnetosphere to ~3-5 R_E (R_E = earth's radius). The system of magnetohydrodynamic shock waves emanating from the magnetic piston gradually is dissipated at heights of ~7-3 R_E. The energy flux of these waves corresponds to the intensity of the field of D_i variations of the geomagnetic field. The considerable heating arising during the motion and dissipation of the magnetic piston and shock waves can lead to the formation of a continuously changing flow of D_i variations. The generation of superthermal particles, continuously emanating from the nonstationary magnetic trap into the polar regions and the generation and dissipation of the current of D_i variations leads to a cooling of the outer magnetosphere. (auth)

44647 TEMPORAL PATTERNS IN THE OCCURRENCE OF ANOMALOUS IONIZATION IN THE F2-LAYER AT HIGH LATITUDES. L. A. Yudovich (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 843-6(1963).

The temporal patterns in the occurrence of anomalous ionization, in the F_2 layer in the unlit ionosphere of the high latitudes of the northern and southern hemispheres are discussed. It is shown that all types of daily changes f_0F2 can be explained on the basis of the concept of the existence of two maxima—a wave maximum at the midday hours and a corpuscular maximum, displaced in time in dependence on geomagnetic latitude. In the region of the auroral zone the maximum of critical frequencies of anomalous ionization in the F2 layer is observed in the early morning hours, and with an increase in geomagnetic latitude moves through the midnight hours to early evening hours local time. (auth)

44648 LATITUDINAL CHANGE OF CONDITIONS FOR OCCURRENCE OF THE F1-LAYER. L. A. Shchepkin (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, Siberia SSR). Geomagnetism Aeronomy, 3: 847-51(1963).

A study was made of the latitudinal change of conditions for occurrence of the F1 layer in a period of high solar activity at solstitial periods. The probability of occurrence of the F1 layer when the sun is low above the horizon has an obvious tendency to an increase with an increase of latitude. The value of the cosine of the solar zenith angle corresponding to the onset of the regular occurrence of the F1 layer in the daily cycle decreases with an increase in latitude; the cosine of the solar zenith angle tends to reach maximum values at geographic latitudes ~20° in the summer hemisphere. An improvement in the conditions for formation of the F1 layer with an increase in latitude also is manifested in an increase of the relative number of cases of a well-developed layer. A study of changes in its seasonal development leads to the same conclusion with respect to latitudinal changes in the conditions for occurrence of the F1 layer. The possible reasons for the latitudinal effect under consideration on the basis of the role of splitting of the maximum of ion formation in the F region of the ionosphere in the formation of the F1 layer are discussed. (auth)

44649 A METHOD OF DETERMINING THE ELECTRON DENSITY PROFILE IN THE D REGION OF THE IONOSPHERE. K. Serafimov and G. Nestorov (Inst. of Geophysics, Academy of Sciences, Bulgaria). Geomagnetism Aeronomy, 3: 852-6(1963).

On the basis of the results of measurements of nondeviative absorption, L'_D, in the D region with moderately high frequencies, it is possible to determine the variation of distribution of electron density with height. For this purpose the integral absorption equation is solved analytically by successive expansion into a Taylor series. Thus, by means of a continucus recording of L'_D during slant in-

cidence of an electromagnetic wave at a number of points or by measurement of absorption at several frequencies in the A1 regime it becomes possible by simple means to determine the profile, N (z), in the D region and control its variations with time. (auth)

44650 THE NATURE OF IRREGULAR FLUCTUATIONS IN DAILY MAGNETIC VARIATIONS. M. N. Fatkullin (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 857-62(1963).

The nonuniform structure of the dynamo region is considered as one of the possible causes of irregular deviations in S_q variations. A method was developed for considering the local effects in the earth's magnetic field caused by local processes in the upper atmosphere. It is demonstrated that irregular deviations from the smooth course of S_q variations can arise both due to local intensification (or attenuation) of anisotropic conductivity in nonhomogeneous formations, and due to their disruption of the field of tidal velocities. (auth)

44651 SOLAR CORPUSCULAR STREAMS AND FAMILIES OF GEOMAGNETIC STORMS AT THE TIME OF THE FLIGHT OF MARINER 2. V. I. Afanaseva (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 904-5(1963).

The configuration and position of solar corpuscular streams in interplanetary space determined from Mariner 2 data were used for checking the determinations of families of magnetic storms. The agreement was satisfactory, thereby confirming the concept of families of storms as a phenomenon caused by the geometry of the earth's passage through corpuscular streams or past these streams. (C.E.S.)

44652 THE BOW SHOCK WAVE IN FRONT OF THE EARTH AND ITS INFLUENCE ON THE RADIATION BELTS. M. A. Gintsburg (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 906-7(1963).

The formation of the radiation belts is explained as the effect of acceleration of particles by radiation. This radiation is postulated to be the plasma waves continuously generated by the bow shock wave in front of the earth. (C.E.S.)

44653 EFFECTS IN THE F2-LAYER OF THE IONOSPHERE AT THE TIME OF SOLAR FLARES. I. N. Odintsova (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 909-11(1963).

An analysis of five cases of effects in the F2 layer at the time of chromospheric flares of importance 3 and 3+ is presented. Only three of the events were accompanied by the arrival of fast particles with energies of 10–100 Mev in the polar cap and by polar absorption of radio waves. The change in the critical frequencies of the F2 layer at the time of these solar flares is discussed. (C.E.S.)

44654 LUNAR TIDAL VARIATIONS OF THE MINIMUM VIRTUAL HEIGHTS OF THE F2-LAYER. V. A. Zagulyaeva (Inst. of Terrestrial Magnetism, Ionosphere and Radio Wave Propagation, Academy of Sciences, USSR). Geomagnetism Aeronomy, 3: 911-13(1963).

A study of tidal variations on the principal ionospheric parameters is presented. An attempt was made to determine the values of the vertical and horizontal rates of migration of ionization under the influence of the gravitational forces acting between the earth and the moon. (C.E.S.)

44655 A PARALLACTIC SURVEY OF AURORAS IN THE VICINITY OF TIXIE BAY. D. A. Andrienko and A. G. Chiryayev (Kiev State Univ. and Inst. of Astrophysical Research and Aeronomy, Academy of Sciences, Yakutian Branch, Siberia SSR). Geomagnetism Aeronomy, 3: 913-14(1963).

A parallactic survey of auroras was made in an attempt to determine the heights of auroras. (C.E.S.)

44656 DISTRIBUTION OF POSITIVE IONS IN THE F-REGION. S. N. Ghosh, K. D. Sharma, and A. Sharma (Univ. of Allahabad, India). Indian J. Phys., 38: 106-17 (Feb. 1964).

The distribution of positive ions in the F region of the ionosphere is controlled mainly by the following processes: photo-ionization of atmospheric constituents, ion-atom interchange, dissociative recombination of molecular ions with electrons, and diffusion and drift of ionization. Of these processes, the rate of production of ions from photo-ionization can be calculated with a fair degree of accuracy from rocket data of the solar spectrum in the ultraviolet and x-ray regions. The rate coefficients of dissociative recombination process are known but the rate coefficients of ion-atom interchange reactions, which are responsible for reshuffling the ions, are not available. From the rocket-borne experimental determination of percentage of ion compositions, the rate coefficients of these reactions are obtained. In order to reproduce the known ion composition, the rate coefficients of ion-atom interchange reactions should vary with altitude. Assuming that the temperature dependence of the above process is analogous to that of a two-body chemical reaction, their altitude variation and activation energies are obtained. The rate coefficient of the reaction, $O^+ + O_2 \rightarrow O_2^+ + O$ at 300°K is found to be 3.07×10^{-11} cm^3/sec which agrees with the experimental value of $2.5 \pm 0.4 \times 10^{-11}$ cm^3/sec obtained by Dickinson and Sayers at the same temperature. (auth)

44657 LOW-ALTITUDE NUCLEAR TEST AND RADIO NOISE LEVEL. Olu Ibukun (Univ. of Ibadan, Nigeria). J. Atmospheric and Terrest. Phys., 26: 795-803(Aug. 1964).

Low-altitude nuclear explosion around Reganne (26°N, 0°E) in the Sahara Desert during February 1960, had effect on radio communication at Ibadan (7°N, 4°E) about 2,000 km from the region of detonation. The nuclear weapon was believed to have been in the kiloton range and exploded from a 300-ft tower. Increased ionization in the ionosphere and enhancement of atmospheric radio noise levels were evidenced at Ibadan. The atmospheric noise levels at all frequencies investigated were affected, but the effects were rather more pronounced at the lower frequencies. The results of the observations suggest that the explosion itself generates electromagnetic energy at least in the radio-frequency band, 51 kc/20 Mc. (auth)

44658 ON THE RELATIONSHIP BETWEEN POLAR-GLOW AURORA AND SOLAR COSMIC RAY FLUXES. R. R. Brown (Kiruna Geophysical Observatory, Sweden). J. Atmospheric and Terrest. Phys., 26: 805-9(Aug. 1964).

Calculations of the λ3914 emission rate due to solar cosmic ray bombardment, based on exponential rigidity spectra for solar protons and alpha particles, are compared with spectrographic observations from the polar regions during PCA events. While limited data on the time variations of polar-glow aurora agree with predictions from observations of solar cosmic ray fluxes, the observed emission

rates exceed calculated values by about an order of magnitude. The bearing of these results on the PCA problem is discussed. (auth)

44659 MICROPULSATION WHISTLERS. J. A. Jacobs and T. Watanabe (Univ. of British Columbia, Vancouver). J. Atmospheric and Terrest. Phys., 26: 825-9(Aug. 1964).

Of the two modes of hydromagnetic waves propagating in a magnetoactive plasma, it is shown that only one mode is likely to be guided by the magnetic field. For this mode, the wave energy is propagated with a faster velocity at a lower frequency. This dispersion characteristic gives support to the view that a series of rising tones on a dynamic spectrum of signals of the so-called pearl type micropulsations is caused by a hydromagnetic wave packet which is guided by a magnetic line of force of the earth echoing between the two conjugate points. (auth)

44660 A STUDY OF THE SPORADIC-E LAYER OVER WALTAIR. M. Mukunda Rao and B. Ramachandra Rao (Andhra Univ., Waltair, India). J. Atmospheric and Terrest. Phys., 26: 831-9(Aug. 1964).

From the fE_s data, manually observed at Waltair, during February 1956 to February 1957 and November 1961 to October 1962, the diurnal and seasonal variation of the occurrence of E_s is studied. An attempt is made to explain the obtained results. The diurnal and seasonal variations of fE_s are studied and the results are in accordance with those obtained at other middle latitude stations. A comparison is made of the diurnal variation of fE_s at Waltair during 1956–1957 with the other Indian stations during the same period. The E_s characteristics at Waltair, except for the percentage occurrence of E_s with $fE_s > 7$ Mc show slight positive correlation with sunspot activity. An analysis of the lunar semi-diurnal tides in fE_s at Waltair is made. (auth)

44661 FADING ANALYSIS OF IONOSPHERIC DRIFT RECORDS. P. S. Kesava Rao and B. Ramachandra Rao (Andhra Univ., Waltair, India). J. Atmospheric and Terrest. Phys., 26: 841-7(Aug. 1964).

Drift data obtained during I.G.Y. period for Waltair (17° 43′N 83° 18′E; Geomag. lat. 7° 4′N) were analyzed, and it is found that the fading frequency varies linearly with drift speed. The fading frequency is found to be finite even when the drift is zero. The effect of magnetic activity on fading frequency versus drift speed relation was studied, and it is found that the relation is once again linear on disturbed days. The fading frequency increases in the E-region and decreases in the F-region on disturbed days compared to quiet days. (auth)

44662 MORPHOLOGY OF STORMS IN THE IONOSPHERE. Tatsuzo Obayashi (Kyoto Univ.). J. Geomagnet. Geoelec., 16: 1-30(1964).

A review is given on the morphology of storms in the ionosphere based on the results obtained during the world-wide cooperative observations, IGY (1957-1958) and IGC (1959). Ionospheric disturbances are classified into two categories: disturbances that take place in the lower ionosphere and F region ionospheric storms. The E region disturbances are mainly caused by an abnormal ionizing agent penetrating into the lower ionosphere. Sudden ionospheric disturbances are due to an outburst of solar x rays associated with chromospheric flares, while polar blackout phenomena are produced by incoming energetic particles. It is shown that solar cosmic ray particles (sub-relativistic ejected from an intense flare are the source of a prolonged blackout in the polar cap region, known as polar cap absorption, and auroral particles consisting presumably of energetic electrons are responsible for auroral blackouts. Average features of these two types of polar blackout are described in some detail with other related geophysical phenomena. F region storms accompanying large electron density variations are closely connected with geomagnetic storms. The disturbances are world-wide, their features being markedly different both with respect to geomagnetic storm-time as well as time of day. The general morphological features of storms are, therefore, described in terms of the storm-time variation, Dst, and the disturbance diurnal variation, Ds. A theoretical interpretation of ionospheric F_2 storms is still incomplete; however, two dominant theories which may explain the main features of electron density variations are discussed in the light of recent knowledge of the ionosphere. It is concluded that the Dst variation may be produced by the effect of thermal heating of the ionosphere during storms, whereas the Ds variation may be related in some way to electrodynamical drift motions of electrons due to the interaction of the geomagnetic field with the electric field induced by the enhanced dynamo-action in the ionosphere. Other disturbance effects in the F region and their connection with exospheric phenomena are also discussed briefly. (auth)

44663 A STUDY OF GEOMAGNETIC EFFECTS ASSOCIATED WITH AURORAL ZONE ELECTRON PRECIPITATION OBSERVED BY BALLOONS. W. H. Campbell (National Bureau of Standards, Boulder, Colo.). J. Geomagnet. Geoelec., 16: 41-61(1964).

Magnetograms and geomagnetic micropulsation data were reviewed for fifteen bremsstrahlung x-ray events detected by balloon borne counters at College, Alaska, from 1960 to 1962. Derived total disturbance field variations and line current electrojet triangulations were of value in interpreting the magnetic field effects associated with the particle precipitation. The micropulsations and rapid fluctuations in auroral zone bays are thought to have their source in the enhanced conductivity created by and local to the particle precipitation. (auth)

44664 A NOTE ON H-VARIATION OF -SI. Y. Sano (Kakioka Magnetic Observatory, Japan). J. Geomagnet. Geoelec., 16: 62-4(1964).

Previous studies of the morphology on the sudden impulse of the geomagnetic field, SI, indicated that negative SI may be caused by the reverse process of positive SI. Namely, it is considered that negative SI may occur when the solar plasma which is compressing the geomagnetic field disappears suddenly from the vicinity of the earth. Evidence is given to support this suggestion. The evidence is found in the H-variation around the time of negative SI. (C.E.S.)

44665 VARIATIONS IN UPPER-ATMOSPHERE DENSITY BETWEEN SUNSPOT MAXIMUM AND MINIMUM. D. G. King-Hele (Royal Aircraft Establishment, Farnborough, Hants, Eng.). Nature, 203: 959-60(Aug. 29, 1964).

It is shown that at heights of 200–800 km the atmospheric density and temperature are strongly under solar influence. They depend on the presence or absence of solar radiation (the day-to-night effect) and also respond vigorously to changes in solar activity. (C.E.S.)

44666 FLUCTUATIONS IN IONOSPHERIC ABSORPTION EVENTS AT CONJUGATE STATIONS. J. K. Hargreaves and H. J. A. Chivers (National Bureau of Standards, Boulder, Colo.). Nature, 203: 963-4(Aug. 29, 1964).

It was previously concluded that fluctuations in ionospheric absorption events are consistent with modulation of the electron precipitation by hydromagnetic waves. No

detailed mechanism for this interaction was proposed. A complementary feature which any theory must take into account is presented, namely, the phase relation between these fluctuations in magnetically conjugate regions. (C.E.S.)

44667 LIFETIMES OF GEOMAGNETICALLY TRAPPED ELECTRONS OF SEVERAL Mev ENERGY. James A. Van Allen (Univ. of Iowa, Iowa City). Nature, 203: 1006-7 (Sept. 5, 1964).

The L-dependence of observed values of the apparent mean lifetime of ~2-Mev electrons from two U. S. and two U.S.S.R. nuclear detonations at high altitudes is discussed. (C.E.S.)

44668 COLLISION FREQUENCY IN THE IONOSPHERE AND SOLAR ACTIVITY. W. J. G. Beynon and E. S. O. Jones (University Coll. of Wales, Aberystwyth, U. K.). Nature, 203: 1159(Sept. 12, 1964).

Three independent sets of data showing a significant positive dependence of the E-layer electron collision frequency on solar activity are discussed. It is indicated that at 110 km the electron temperature at noon may exceed the neutral gas temperature by a factor of about two. (C.E.S.)

44669 HEIGHTS OF CENTRAL ABSORBING REGIONS FOR A STRONG AURORAL ABSORPTION EVENT AT LOWER LATITUDE. J. S. Kim and J. D. Kleinkopf (Univ. of Idaho, Moscow). Nature, 203: 1160-1(Sept. 12, 1964).

The heights of central absorbing regions for the strong auroral absorption events of Sept. 22, 1963, which were deduced by utilizing the relaxation time method introduced by Ziauddin, are reported. The method relies on the fact that the absorption suffered by a radio wave in the lower ionosphere is proportional to the number of electrons encountered in the absorbing region and is a function of the collision frequency of the electrons. (C.E.S.)

44670 A SOURCE OF THE ENERGY FOR GEOMAGNETIC STORMS AND AURORAS. S.-I. Akasofu (Univ. of Alaska, College). Planetary Space Sci., 12: 801-33(Sept. 1964).

It is shown that an enhancement of the ionized component of the solar plasma flow or intense turbulent motions contained in it does not introduce substantial energies into the magnetosphere for the ring current belt and auroral substorms. The role of energetic neutral hydrogen atoms is then examined as a possible source of the energy for the ring current belt. The course of the development of auroral substorms over the entire polar region suggests that their energy is not directly introduced into the magnetosphere across the boundary and that a source of their energy is stored in the magnetosphere in an invisible form before it is converted into the substorm energy. Again, the neutral hydrogen atoms are a possible source of the energy, which can be stored in the ring current belt. A possible conversion mechanism of the ring current energy into the auroral substorm energy is suggested. (auth)

44671 PERIODIC FLUCTUATIONS IN THE GEOMAGNETIC FIELD DURING MAGNETIC STORMS. G. L. Pai and V. A. Sarabhai (Physical Research Lab., Ahmedabad, India). Planetary Space Sci., 12: 855-65(Sept. 1964).

Some of the characteristics of the periodic fluctuations occurrring in the horizontal intensity (H) of the earth's magnetic field during magnetic storms were investigated, using the five minutes values of H at Huancayo, Trivandrum, Alibag, Honolulu, and San Juan during the storm of July 8, 1958. The study was extended to sixteen sudden commencement and twenty gradual commencement storms at Huancayo during 1958 using 5-min values of H at Huancayo. Adopting the method of auto-correlation analysis, the period of oscillations of the significant fluctuations was found to be generally about 40 min. The oscillations occur generally during the initial and main phases of the storm. The fluctuations are in phase at the two equatorial stations of Huancayo and Trivandrum or Huancayo and Alibag. They are therefore simultaneous at stations round the earth close to the geomagnetic equator. At Honolulu or San Juan, the fluctuations are irregular and are poorly correlated with those at the equatorial stations. The situation at a high-latitude station such as Sitka was not studied. On the assumption that the periodic fluctuations are due to large scale inhomogeneities in the solar plasma impinging on the magnetosphere, the average scale length of the inhomogeneities in the plasma was calculated to be 0.02 a.u. This scale length is comparable to the scale length of inhomogeneities derived by McCracken from solar-flare cosmic-ray events and the scale length indicated in the experimental results by Bryant relating to energetic particles measured by Explorer XII. (auth)

44672 THE EFFECT OF SOLAR FLARES ON THE [OI] GREEN LINE OF THE NIGHTGLOW. B. S. Dandekar and S. M. Silverman (Air Force Cambridge Research Labs., Bedford, Mass.). Planetary Space Sci., 12: 867-74(Sept. 1964).

Observational evidence is presented establishing the enhancement of the [OI] green line emission of the airglow on the night following a prominent solar flare. The hypothesis that the enhancement arises from extra dissociation of molecular oxygen produced by the ultraviolet energy from the solar flare is considered. It appears to be tenable only if a major part of the energy radiated by the flare lies in the Schumann-Runge continuum. (auth)

Low Temperature Physics

Refer also to abstracts 43920 and 44219.

44673 (AD-604097) ANOMALOUS CURRENT PEAKS IN THE I-V CHARACTERISTIC FOR TUNNELING BETWEEN TWO SUPERCONDUCTORS. M. G. Craford, R. N. Peacock, R. P. Ries, and C. B. Satterthwaite (Illinois. Univ., Urbana. Coordinated Science Lab.). Aug. 1964. Contract DA-28-043-AMC-00073(E). 14p. (R-232)

Josephson tunneling at zero-voltage, and d-c current peaks of comparable magnitude at finite voltage, were observed in sandwiches of Nb–Nb oxide–In immersed in liquid He. (R.E.U.)

44674 (BNL-8410) FIELD PENETRATION IN SUPERCONDUCTORS WITH SURFACE LAYERS. Donald G. Schweitzer, Paul P. Craig, Myron Strongin, and Arthur Paskin (Brookhaven National Lab., Upton, N. Y.). [1964]. Contract AT(30-2)-Gen-16. 14p. (CONF-651-7)

From 9th International Conference on Low Temperature Physics, Columbus, Ohio, Aug.-Sept. 1964.

Low-frequency low-field a-c susceptibility measurements made in swept d-c fields are reported. The results show that the small a-c field has penetrated the superconductor in the mixed state, and can thus be used to investigate the bulk properties of type II superconductors. Magnetization and a-c measurements were made on a series of cylindrical alloy samples subjectd to various surface treatments with both fields parallel to the axes of the samples. Models were used to interpret the results. (R.E.U.)

44675 (BSD-TDR-64-110) CURRENT TRANSFER IN CONTACTS INVOLVING SUPERCONDUCTORS. Research Report No. 193. E. Lucas, Z. J. J. Stekly (Avco Corp. Avco-Everett Research Lab., Everett, Mass.), C. Laverick, and G. Pewitt (Argonne National Lab., Ill.). Sept. 1964. Contracts AEC-31-109-38-1498; AF04(694)-414; and NAS8-5279. 37p. (CONF-554-10)

From Cryogenic Engineering Conference, Philadelphia, Aug. 1964.

A theoretical analysis for the transfer of current between a power lead and a superconductor is given. This analysis assumes that a uniformly distributed surface resistivity exists between the superconductor and the normal conductor. Experimental results with contacts between superconductors and power leads were obtained during the course of experiments with short samples and small solenoids. These results are presented. The theoretical predictions were checked experimentally, and the results are given. It is concluded that the maximum current, which can be transferred through a joint, is a function of the following: (1) The magnitude and direction of the magnetic field at the joint, (2) the cooling of the joint; and (3) the contact resistance. Joints should be located in low field regions and aligned parallel to the magnetic field. Reliability can be improved by paralleling joints. Crimped joints with indium coated wires and tubes are satisfactory for most applications. (auth)

44676 (ORNL-P-488) HIGH-FIELD SUPERCONDUCTORS AND THE DEVELOPMENT OF SUPERCONDUCTING MAGNETS. W. F. Gauster (Oak Ridge National Lab., Tenn.). [nd]. Contract [W-7405-eng-26]. 19p. (CONF-724-1)

From German Physical Society Conference, Dusseldorf, Ger., Oct., 1964.

Some experiments on high-field superconductors (type III) are reviewed. Models used to describe HFSC are discussed. (R.E.U.)

44677 MEASUREMENT OF 50 c/s LOSSES IN SUPERCONDUCTORS. R. G. Rhodes, E. C. Rogers, and R. J. A. Seebold (B.I.C.C. Research Organization, London). Cryogenics, 4: 206-8(Aug. 1964).

A calorimetric method is used to determine the a-c power losses in Pb, Nb, and Nb–Zr wire samples at 4.2°K and 50 cps, over a wide range of current densities up to the critical current densities. No magnetic fields are applied externally. Surface currents are found to be appreciable. (T.F.H.)

44678 SUPERCONDUCTIVE POWER SUPPLY AND ITS APPLICATION FOR ELECTRICAL FLUX PUMPING. T. Buchhold (General Electric Co., Schenectady, N. Y.). Cryogenics, 4: 212-17(Aug. 1964).

With a model it is shown that with cryotrons and saturable reactors a controllable superconductive power supply without moving parts can be built. It was possible to charge and discharge a superconductive coil and to produce permanent currents. (auth)

44679 THE INFLUENCE OF IMPURITIES AND SOLUTES (PRIMARILY ZIRCONIUM) ON THE HIGH-CURRENT-CARRYING, HIGH-FIELD Nb_3Sn SUPERCONDUCTOR. W. DeSorbo (General Electric Research Lab., Schenectady, N. Y.). Cryogenics, 4: 218-32(Aug. 1964).

The effects of impurities and solutes (primarily Zr), present in Nb prior to its heat treatment in Sn to form Nb_3Sn, upon the superconducting properties of the Nb_3Sn are studied. These impurities are found to enhance and improve the current-carrying characteristics of the Nb_3Sn. Two methods for fabricating the Nb_3Sn samples are considered. (T.F.H.)

44680 NUCLEATION CHARACTERISTICS OF STATIC LIQUID NITROGEN AND LIQUID HYDROGEN. Jesse Hord, R. B. Jacobs, C. C. Robinson, and L. L. Sparks (National Bureau of Standards, Boulder, Colo.). J. Eng. Power, 86: 485-94(Oct. 1964).

Characteristics that control the existence of metastable (superheated) liquid states and the nucleation of the vapor phase were studied; knowledge of these characteristics will assist in the prediction of cavitation in hydraulic equipment. The liquids were superheated by reducing the ullage pressure in a vessel of liquid that was initially in thermodynamic equilibrium. Experimental superheat limit curves for liquid nitrogen and liquid hydrogen, statically contained in a nearly ideal (acid cleaned, smooth glass) system, are presented and compared with theoretical limit curves. The effects of some nonideal liquid-solid interfaces on the nucleation characteristics were studied and are also included. The theory developed is in fair agreement with the experimental data for the nearly ideal system. Persistence of the metastable state is shown to be dependent upon the rate of pressure decay, the initial equilibrium pressure, fluid environment, and the nucleation pressure. Appreciable superheat persisted for long times with liquid nitrogen (44.2 psi superheat persisted for 4.3 sec at 90°K) while the persistence times for liquid hydrogen were much shorter (48.7 psi superheat persisted for only 0.030 sec at 26.7°K). (auth)

44681 METALLURGICAL AND TECHNOLOGICAL PROBLEMS OF HARD SUPERCONDUCTORS CONSISTING OF Nb- AND Ti-BASE ALLOYS. U. Zwicker (Forschungsinstitut für Edelmetalle und Metallchemie, Schwäbish Gmünd, Ger.). Metall, 18: 941-8(Sept. 1964).

The metallurgical and technological data obtained in studies of hard superconductors of Nb and Ti alloys were compiled. The transition temperature and probably also the critical field strength is determined by the atomic structure of the metals and alloys. The valence electron concentration plays a significant role. Since the atomic structure can be altered by heat treatment or deformation in many cases, these types of treatment are often decisive for obtaining an optimum transition temperature and field strength. The critical current intensity is displaced through the formation of lamellar structures to optimum values. (J.S.R.)

44682 SUPERCONDUCTING PERMANENT MAGNETS FROM Nb_3Sn AT 14°K. F. Lange. Monatsber. Deut. Akad. Wiss., Berlin, 6: 294(1964).

Experiments in generating strong magnetic fields in a hollow cylinder were undertaken with the consideration that the use of wire coils has various disadvantages, particularly in the case of Nb_3Sn, whereas the cylinders make it possible to obtain average current density values in relation to the external field. Inasmuch as this is a contactless measurement the compound can be resintered many times and new measurements taken. Suitable sintering conditions for compounds of varied composition were determined from experiments carried out at liquid hydrogen temperatures. In view of the fact that it is more difficult to set up strong fields with hollow cylinders, since the field may collapse, the conditions under which the collapse occurs were determined and a relationship between the quality of the compounds and the tendency to form cracks was established. It was found that a hollow cylinder with an outside diameter of 12 mm, an inside diameter of 1 mm, and a height of 3 mm can set up a field of 15 kOe at 14°K. (OTS)

44683 RESEARCH ON MATERIALS FOR SUPERCONDUCTING MAGNETS. F. Lange. Monatsber. Deut. Akad. Wiss., Berlin, 6: 305-9(1964).

Various means of evaluating materials for superconducting magnets are described. It is shown that determination of jump point and transition width from the resistance–temperature relationship, entailing the use of contacts, has inherent deficiences. For this reason preference is given to magnetic susceptibility, which changes abruptly at the jump point. Equipment design for this measurement is described. In determining critical current strength, contacts again have practical disadvantages, particularly with high or low strengths of resistance, field, and current, and a contactless method is outlined that permits continuous alternation between heat treatment and measurement. Graphs of these three phenomena are presented, with Nb_3Sn employed as the superconducting material. Conditions for the use of liquid nitrogen as a coolant are indicated, and the employment of pulsed magnetic field for field strengths above 31 kOe is discussed. (OTS)

44684 THE MEANING OF SUPERFLUIDITY. K. Mendelssohn (Oxford Univ.). New Scientist, 23: 772-5(Sept. 24, 1964).

A brief historical review of the investigations of the superconducting phenomena in liquid helium is presented. Recent experiments on superfluidity in helium-3 are discussed, and an attempt is made to explain the physical significance of superfluidity. (C.E.S.)

44685 SUPERCONDUCTIVITY IN Cu AND Pt BY MEANS OF SUPERIMPOSED FILMS WITH LEAD. J. J. Hauser, H. C. Theuerer, and N. R. Werthamer (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev., 136: A637-41(Nov. 2, 1964).

The study of normal-superconducting sandwiches provides information on the type of electron-electron interaction taking place in the normal metal. The magnitude and sign of the interaction are obtained by comparing a characteristic length, which measures the depth of penetration of electron pairs in the normal metal, with the effective coherence length. In order to study the electron-electron interaction in copper and platinum, superimposed films of lead-platinum and of lead-copper were deposited on glass substrates kept at 77°K. It has been shown that the effective coherence length should be calculated from the coefficient of normal electronic specific heat and the residual resistivity. The data were then plotted in such a way as to exhibit all the temperature dependence in one term, and the slope of such a plot is the depth of penetration of electron pairs in the normal metal. With the experimental accuracy presently available, the electron-electron interaction in platinum can be bracketed between −0.25 (repulsive interaction) and an attractive interaction of +0.09 ($T_c = 2 \times 10^{-3}$°K). In the case of copper, the data correspond to a transition temperature of about 6 mdeg. (auth)

44686 ULTRASONIC PROPAGATION NEAR THE CRITICAL POINT IN HELIUM. C. E. Chase, R. C. Williamson, and Laszlo Tisza (Massachusetts Inst. of Tech., Cambridge). Phys. Rev. Letters, 13: 467-9(Oct. 12, 1964).

A reconsideration of theory in view of the observation of a logarithmic singularity in the specific heat at constant volume at the critical point in argon and oxygen indicated that the adiabatic compressibility has a singularity at the critical point, while the sound velocity vanishes. Measurements of the sound velocity in the critical region of helium supported a vanishing velocity at the critical point. The singularity in the adiabatic compressibility was also verified. (D.C.W.)

44687 RESISTIVITY EVIDENCE FOR A PHASE TRANSFORMATION IN "β-TUNGSTEN" TYPE SUPERCONDUCTORS. J. J. Hauser (Bell Telephone Labs., Murray Hill, N. J.). Phys. Rev. Letters, 13: 470-1(Oct. 12, 1964).

A jump in the resistivity of β-tungsten superconductors was observed at approximately the same temperature at which the martensitic transformation was found by x rays. The anomaly was observed in several A-15 type superconductors. The martensitic transformation appears to be related to the superconductivity. (D.C.W.)

44688 THE EFFECT OF DISLOCATION CONFIGURATION ON THE SUPERCONDUCTING PROPERTIES OF NIOBIUM AND VANADIUM. A. V. Narlikar and D. Dew-Hughes ([Cambridge Univ., Eng.]). Phys. Status Solidi, 6: 383-90(1964).

Magnetization measurements were made on various annealed and cold-worked niobium and vanadium specimens in the superconducting state. The microstructure of these specimens was studied by transmission electron microscopy. The observed variation in magnetization was correlated with the dislocation configuration present in the material. The results are explained on the assumption that flux lines are trapped by an interaction with dislocation tangles, the interaction arising through a local reduction in the range of coherence. (auth)

44689 SUPERCONDUCTING MAGNETS AND HARD SUPERCONDUCTIVITY. Y. B. Kim. Phys. Today, 17: No. 9, 21-30(Sept. 1964).

The status of superconducting magnets is reviewed, including design criteria and relations, performance, and fabrication techniques. Theory for hard superconductivity is then outlined, considering flux migration and structures, power dissipation, and instabilities, as well as associated experimental observations. (D.C.W.)

44690 EFFECTS OF THERMAL TREATMENT ON THE PROPERTIES OF Nb + Zr SUPERCONDUCTING ALLOYS WITH Zr BASE. Yu. F. Bychkov, I. N. Goncharov, V. I. Kuz'min, and I. S. Khukhareva (Joint Inst. for Nuclear Research, Dubna, USSR). Pribory i Tekhn. Eksperim., No. 3, 170-1(May-June 1964). (In Russian)

The dependence of critical current density and critical temperature on the temperature of intermediate annealing was studied for Nb–Zr alloys containing 65 to 80% Zr. The maximum temperature for Nb–80% Zr was 400 to 500°C; for Nb–65% Zr, 650 to 750°C. It was shown that the increase of critical current density after annealing is conditioned not by the formation of new phases, but by a change of the structure of the β-phase solid solution or by the separation of the metastable ω phase. (tr-auth)

44691 THE GINZBURG-LANDAU EQUATIONS FOR PURE TWO BAND SUPERCONDUCTORS. D. R. Tilley (Mullard Research Labs., Redhill, Surrey, Eng.). Proc. Phys. Soc. (London), 84: 573-84(Oct. 1964).

The Ginzburg-Landau equations are derived, following the method of Gor'kov, for superconductors with two bands at the Fermi surface which are pure enough to have two energy gaps. The condition for the material to be a type II superconductor is obtained. The condition is considered for transition metals, with reasonable assumptions about the parameters involved, and it is shown that the superconductor becomes more "soft" as the coupling between the bands becomes stronger. (auth)

44692 PROGRESS IN LOW TEMPERATURE PHYSICS. VOLUME IV. C. J. Gorter, ed. Prog. Low Temp. Phys.,

4: 1-530(1964). Amsterdam, North-Holland Publishing Company, 1964. $17.60.

Critical velocities and vortices in superfluid helium, equilibrium properties of liquid and solid mixtures of helium-3 and -4, the superconducting energy gap, anomalies in dilute metallic solutions of transition elements, magnetic structures of heavy rare-earth metals, magnetic transitions, the rare-earth garnets, dynamic polarization of nuclear targets, thermal expansion of solids, and the 1962 ^{3}He scale of temperatures are discussed. Separate abstracts are prepared for 9 of the 10 chapters. An abstract of one of the chapters previously appeared in NSA (18: 40463). (C.E.S.)

For abstracts of individual chapters see: 44215, 44216, 44217, 44218, 44219, 44693, 44694, 44695, and 44831.

44693 CRITICAL VELOCITIES AND VORTICES IN SUPERFLUID HELIUM. V. P. Peshkov (Inst. for Physical Problems, Moscow). Prog. Low Temp. Phys., 4: 1-37 (1964).

The breakdown of superfluidity is discussed. Critical velocities in narrow channels, slits, and films, critical velocities in wide channels, the oscillation of discs and spheres in superfluid helium to determine critical velocities, persistent currents, the Landau criterion and excitations in the superfluid and quantized vortex lines are considered. A bibliography of 45 references is included. (C.E.S.)

44694 EQUILIBRIUM PROPERTIES OF LIQUID AND SOLID MIXTURES OF HELIUM THREE AND FOUR. K. W. Taconis and R. de Bruyun Ouboter (Kamerlingh Onnes Laboratorium, Leiden). Prog. Low Temp. Phys., 4: 38-96 (1964).

The equilibrium between vapor and liquid mixtures of ^{3}He and ^{4}He, calculation of the excess chemical potentials and the excess Gibbs function, the equilibrium between vapor and dilute liquid mixtures of ^{3}He in ^{4}He II, the equilibrium between the He I and the He II phase (λ-line) and between two liquid mixtures in the stratification region, the lambda transition, the Keesom-Ehrenfest relations for a liquid mixture and the discontinuity in the slope of the first order equilibrium curves at the junction with the second order lambda curve, the phase separation diagram, the osmotic equilibrium in He III, the osmosis in He II derived from the equilibrium between pure liquid ^{4}He on one side and a mixture on the other side of a semipermeable wall, the quasi-equilibrium between the osmotic and the fountain force in the liquid mixture when a heat current is present, the quasi-equilibrium between two mixtures of slightly different concentration in the He II region separated by a capillary, the quasi-equilibrium between two liquid mixtures of different concentration in the He II region connected by the helium surface film, a refrigeration cycle as an application fo the osmotic pressure and the heat of mixing, the equilibrium between liquid and solid mixtures and the phase separation of solid mixtures, the freezing pressures of ^{3}He–^{4}He mixtures, the equilibrium between two solid mixtures in the phase separation region, and the minima in the freezing curves of ^{3}He–^{4}He mixtures and the minima in the melting curves of pure ^{3}He and pure ^{4}He are discussed. A bibliography of 89 references is included. (C.E.S.)

44695 THE SUPERCONDUCTING ENERGY GAP. D. H. Douglass, Jr. and L. M. Falicov (Univ. of Chicago). Prog. Low Temp. Phys., 4: 97-193(1964).

The historical development of the idea that an energy gap could be responsible for the superconducting properties of metals is outlined. The physical significance of an energy gap, the theory of the superconducting energy gap, the theory of superconducting tunneling, and the experimental determination of the energy gap are discussed. A bibliography of 154 references is included. (C.E.S.)

44696 PAULI PARAMAGNETISM AND SUPERCONDUCTING STATE. Kazumi Maki and Toshihiko Tsuneto (Kyoto Univ. and Osaka Univ.). Progr. Theoret. Phys. (Kyoto), 31: 945-56(June 1964).

The effect of the Pauli paramagnetism on superconductors is studied in detail. It is shown that the phase transition due to the paramagnetic effect changes its order from the first to the second as temperature increases. The modification of the mixed state in superconductors of the second kind is also investigated. (auth)

44697 ON THE THEORY OF SUPERCONDUCTIVITY OF THE TRANSITION METALS. Hang-sheng Wu. Wu Li Hsueh Pao, 20: 696-8(July 1964). (In Chinese)

44698 CRITICAL CURRENTS OF Nb_3Sn AND V_3Ga IN TRANSVERSE MAGNETIC FIELDS UP TO 150000 OERSTEDS. J. Babiskin, P. G. Siebenmann, G. Otto, and E. Saur (Naval Research Lab., Washington, D. C. and Universität, Giessen, Ger.). Z. Physik, 180: 483-8(1964).

The quenching curves of some high-field superconductors were measured for the first time in steady transverse magnetic fields up to 150 kOe. The quenching curves of Nb_3Sn diffusion-layers on single niobium wires show the same slope in the high-field region as they do in lower fields. On the other hand, the quenching curves of Nb–Sn multiwires with a synthetic filamentary structure of many interior Nb_3Sn diffusion-layers in the core of this material are nearly horizontal in the high-field region with very high critical current values. The quenching curves of V_3Ga diffusion-layers and of V_3Ga core-wires show an unexpected inversion at about 90 and 100 kOe respectively with increasing critical currents in higher fields. (auth)

44699 CONSTRUCTION OF HIGH PRESSURE CRYOGENIC VESSELS. G. S. Sangdahl, Jr. and L. C. Wilson (Chicago Bridge and Iron Co., Birmingham, Ala.). New York, American Society of Mechanical Engineers, 1964, Paper No. 64-PET-17, 12p. $1.00. (CONF-688-1)

From Petroleum Mechanical Engineering Conference, Los Angeles, Sept. 1964.

The large increase in the use of oxygen, nitrogen, hydrogen, methane, and other gases for industrial purposes has greatly increased the need for storage of these gases. This can most efficiently and safely be done as a liquefied gas at a temperature below the boiling point of the gas and at atmospheric pressure. Special applications may require high pressure storage. This article describes the many factors which must be considered in the construction of high pressure cryogenic vessels: such as; design, material selection, forming, welding, heat treatment, inspection, and cleaning. (auth)

Neutron Physics

44700 (AAEC/E-126) PEAS—A RESONANCE ABSORPTION PROGRAMME. J. P. Pollard (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South Wales). Aug. 1964. 35p.

Details are given of a 7090 FORTRAN computer program to calculate the neutron absorption in individual symmetric, single-level, Doppler-broadened Breit-Wigner resonances

for a homogeneous system of two nuclides. The flux used in determining the resonance absorption is calculated from the numerical solution of the slowing-down integral equation. (auth)

44701 (GAMD-2887) FORTRAN ECTOPLASM PROGRAM. Y. D. Naliboff (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Jan. 25, 1962. Contract AT(04-3)-167. 16p.

The program (IBM 7090) converts observed neutron time-of-flight spectra measured at a linac into energy spectra. (R.E.U)

44702 (GAMD-2906) MILNE PROBLEM FOR A MULTIPLYING SYSTEM. D. E. Parks (General Atomic Div., General Dynamics Corp., San Diego, Calif.). Jan. 31, 1962. Contract AT(04-3)-167. 8p.

The extrapolation distance for an energy-dependent mean free path for the case of a homogeneous multiplying source-free half-space is considered. Under the condition $k_\infty = 1$, the problem is appropriate to the determination of the proper boundary conditions for studies in critical and subcritical assemblies in asymptotic reactor theory. (R.E.U.)

44703 (IDO-16984) A MACHINE PROGRAM FOR CALCULATING SLOW NEUTRON SCATTERING CROSS SECTIONS WITH APPLICATION TO WATER. H. L. McMurry and L. J. Gannon (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). July 1964. Contract AT(10-1)-205. 52p.

The scattering by an atom in a complex molecular aggregate is calculated from an equation involving factors associated with the over-all translational and rotational degrees of freedom of the aggregate, together with its internal vibrations. The rotational and translational factors are quite easy to calculate. The vibrational factor appears as an infinite sum of terms associated with all possible mechanisms of excitation and de-excitation of the normal modes. For practical purposes it is necessary to limit the number of modes that contribute terms to the vibrational factor by treating modes classically whenever the energy transfer in a collision exceeds the quantum spacing of a vibrational level sufficiently. Furthermore, computations must be restricted to only the significant terms in the vibrational factor. The report sets out criteria for treating modes classically, and for selecting only the significant terms in the vibrational factor. A FORTRAN IV program for making the calculations on the IBM 7040 is described. To illustrate the method and the program, calculations are made for water using the Nelkin model and two elaborations of the Nelkin model which allow for more internal vibrational degrees of freedom. The added complexity yields much better agreement between observed and calculated partial differential scattering cross section data for water. (auth)

44704 (IDO-16998) MULTIGROUP ONE-DIMENSIONAL SPHERICAL HARMONIC SOLUTIONS TO THE BOLTZMANN TRANSPORT EQUATION. D. R. Metcalf (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). June 1964. Contract AT(10-1)-205. 56p.

Useful multigroup equations are derived for calculating the isotropic flux in a slab or cylindrical reactor cell. Full details are given of the reduction of the Boltzmann transport equation to spherical harmonic theory including putting the slowing-down differential scattering cross section in a form suitable for calculation purposes. (auth)

44705 (KAPL-M-6151) SCATTERING KERNEL EFFECTS ON FUEL AND POISON DEPLETION RATES. J. D. Jenkins (Knolls Atomic Power Lab., Schenectady, N. Y.). Apr. 1964. Contract W-31-109-eng-52. 34p.

Slab configurations were depleted using reaction rates calculated by SWAKRAUM with a variety of hydrogen scattering kernels and a depletion code, DEPLE for Philco 2000, which is described in the report. Eigenvalue calculations were made on the depleted models to determine the sensitivity of reactivity to the variation in fuel and poison distribution caused by the different hydrogen scattering kernels. Results indicate that core depletion is insensitive to the hydrogen scattering kernel used. Slight variations in poison and fuel spatial distributions at 50% depletion are observed but the effect of this variation causes eigenvalue variations of less than 1%. Steady-state xenon density showed the largest sensitivity to the scattering kernel with variations of the order of 5% in the xenon concentration for different kernels. (auth)

44706 (KAPL-M-6175) SWAK-36—A 36-GROUP SWAK LIBRARY. D. Bollacasa, F. D. Federighi, and D. T. Goldman (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 11, 1964. Contract W-31-109-eng-52. 28p.

A 36-group library was developed for the SWAK thermal cross section program to reach a higher cutoff energy. This is deemed advisable to reduce the effect of an improperly treated up-scattering. The procedure and the equations necessary to calculate the data in the library are discussed and exhibited in detail. (auth)

44707 (NAA-SR-Memo-9886) RECENT DEVELOPMENTS IN RESONANCE INTEGRAL THEORY. R. H. Sevy (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). May 25, 1964. Contract AT-11-1-GEN-8. 14p.

Advances in the theory of resonance capture over the past few years are discussed. It is suggested that the analytical theory is now sufficiently refined as to give results of comparable accuracy to those of more lengthy numerical procedures. (auth)

44708 (NAA-SR-Memo-9965) AGE OF FISSION NEUTRONS TO INDIUM RESONANCE ENERGY IN ZIRCONIUM–WATER MIXTURES. PART II. THEORY. H. Alter (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). [1967]. Contract AT-11-1-GEN-8. 118p.

The Monte Carlo code TYCHE-III was used to calculate the second, fourth, and sixth spatial moments of the slowing-down density distribution at the indium resonance energy, for neutrons originating from a fission source at a point in an infinitely extended homogeneous mixture of zirconium and water. The effects of both inelastic scattering and anisotropy of elastic scattering, in zirconium and oxygen, were included. These calculations are compared with the moments of experimentally measured distributions of neutron flux at the indium resonance energy, after a correction from slowing-down moments to flux moments is applied. The program was written in FORTRAN for IBM 7094. (auth)

44709 (WAPD-T-1634) A RE-ANALYSIS OF STARR AND KOPPEL'S DATA ON DIFFUSION HARDENING. W. W. Clendenin (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). July 1963. Contract AT(11-1)-Gen-14. 7p.

Starr and Koppel Nucl. Sci. Eng., 14: 224(1962)) measured the diffusion length in boric acid solutions and analyzed the data to obtain the neutron pulse parameters for water. In the analysis, experimental values for the higher boron concentrations were omitted. A re-analysis of the data was carried out, and the resulting C and D coefficients are tabulated. It is concluded that Starr and Koppel's data are valid. (D.L.C.)

44710 MEASUREMENT OF THE SLOWING-DOWN TIME OF Ra–Be NEUTRONS IN WATER. Gudmar Grosshoeg (Chalmers Univ. of Tech., Goteburg). Arkiv Fysik, 27: 215-26(1964).

The time for slowing down of Ra–Be neutrons to the cadmium and gadolinium cut-off energies in water was measured with a stationary method to 1.60 ± 0.07 and 2.47 ± 0.11 μsec respectively. The method uses the fact that the cut-off ratio of the total neutron population in a moderating medium is equal to the ratio between the total mean life time and the mean life time of the neutrons above cut-off. For a medium having 1/v absorption the cut-off ratio is directly related to the slowing-down time. The measurements were performed with a small BF_3 proportional counter and with filters of cadmium and gadolinium having cut-off energies at 0.5 and 0.3 ev respectively. It is shown that the correction for the flux perturbation of a gas detector can be calculated with sufficient accuracy using the P_1-approximation. (auth)

44711 PRODUCTION OF 28-Mev NEUTRONS AND MEASUREMENT METHOD FOR TOTAL CROSS SECTIONS. G. Deconninck, A. Gonze, P. Macq, and J. P. Meulders. Bull. Soc. Belge Phys., Ser. II, No. 9, 530-4(1961). (In French)

A method for the production of 28-Mev neutrons, based on the reaction of a deuteron beam with a tritium target, is described. The neutron energy varies with the angle of emission and is 28 Mev at 0°. The number of neutrons emitted at 0° is 6.8×10^7/srxsec for a 1 μ amp deuteron beam. The transmission method is used for the measurement of the total cross section. Values obtained for Al, Mg, Zn, As, S, P, Na, and I are reported. (J.S.R.)

44712 PROPAGATION OF MONOKINETIC NEUTRON WAVES IN DISSIPATIVE MEDIA. (COMPARISON BETWEEN THE TELEGRAPHIST'S EQUATION AND THE FIRST ORDER DIFFUSION ONE). F. Di Pasquantonio (ENEL, Milan). Energia Nucl. (Milan), 11: 465-95(Sept. 1964).

The correct P_1 approximation of the one-velocity transport equation is a partial differential equation containing the first and second derivatives of the flux with respect to time. The frequency limits within which the steady-state solutions of the first-order diffusion equation and the telegraphist's equation are practically equivalent are investigated, together with their divergence when the frequency of the neutron source tends to infinity. The general solution of the telegraphist's equation corresponding to two particular geometries (semi-infinite medium and infinite slab) is obtained for fixed boundary and arbitrary initial conditions. (D.C.W.)

44713 REDUCTION OF TRANSPORT THEORY TO MULTIGROUP DIFFUSION THEORY. G. C. Pomraning (General Atomic Div., General Dynamics Corp., San Diego, Calif.). J. Nucl. Energy, Pts. A & B, 18: 497-512(Sept. 1964).

It is shown that all aspects of multigroup diffusion theory can be derived from the general transport equation (written so as to properly account for the thermal motion of the medium) by utilizing only two assumptions, both of which are implicit in any multigroup derivation. These are: that the directional neutron density within each group is separable according to $n(r,v,\Omega) = n(r,\Omega)n(v)$; and that the angular dependence of $n(r,\Omega)$ is expandable in a truncated spherical harmonic series. These assumptions lead to a diffusion coefficient defined by an energy average of the transport cross section. It is also shown that the spectrum equation, needed to compute the multigroup constants, can be derived using only the first assumption. Secondly, some of the more interesting (and sometimes neglected) aspects of multigroup diffusion theory are reviewed. In particular: the diffusion coefficient matrix contains off-diagonal terms and thus the simple Fick's Law of diffusion does not hold within each group; and the molecular motion of the medium enters into the calculation of the thermal group constants twice, first in computing the spectrum, and second, in computing the energy-dependent "cross sections" to be averaged over this spectrum. (auth)

44714 THE SOLUTION OF INTEGRAL TRANSPORT EQUATIONS IN CYLINDRICAL GEOMETRY USING THE GAUSSIAN QUADRATURE FORMULA. K. Kobayashi and H. Nishihara (Kyoto Univ.). J. Nucl. Energy, Pts. A & B, 18: 513-22(Sept. 1964).

The monoenergetic integral transport equation in a cylindrical geometry is converted into a system of linear equations by use of the Gaussian quadrature formula, and neutron flux is obtained by solving this system by means of an elimination method using a digital computer. Since the application of n-point Gaussian quadrature formula is equivalent to approximating the integrand by a polynomial of degree $2n - 1$, the method gives in general higher accuracy with relatively few sample points than the trapezoidal rule, which approximates the integrand by straight lines. In a sample calculation, it becomes apparent that the thermal neutron flux obtained by using the Gaussian quadrature formula in a lattice cell of light water and enriched uranium converges more rapidly with increasing number of sample points than that obtained by using the trapezoidal rule, and 2-point Gaussian formula is comparable with 6-point trapezoidal rule. (auth)

44715 MEASUREMENT OF NEUTRON LIFE IN A D_2O-SYSTEM BY NEUTRON FLUCTUATION. Yorio Gotoh (Japan Atomic Energy Research Inst., Tokyo). J. Nucl. Sci. Technol. (Tokyo), 1: 193-6(Sept. 1964).

The neutron life was determined in a D_2O system by combining observation of the inherent fluctuations that occur in the neutron population and reactivity measurements by period method. The ratio of variance to mean number of counts was measured as a function of counting intervals. Short counting-time intervals were chosen in the experiment to eliminate contribution of delayed neutrons. Also, the variance was measured in the subcritical state, to eliminate the counting loss due to the dead time of the detector. The decay constant for the critical state was determined by extrapolation of the observed relation between the decay constant and reactivity. (auth)

44716 THERMAL-NEUTRON TRANSMISSION THROUGH PLANE CADMIUM COVERS. J. A. DeJuren and R. K. Paschall (Atomics International, Canoga Park, Calif.). Nucl. Sci. Eng., 20: 314-17(Nov. 1964).

The transmission of thermal neutrons through Cd covers as a function of Cd thickness was measured in a graphite stack at various heights above the thermal column of the AE-6 water-boiler reactor. Both Dy alloy and In alloy foils were used as detectors and were beta-counted. Because the thermal flux incident on a Cd cover is depressed relative to the flux incident on a bare foil, a foil with a thick Cd cover on one side only was used for the zero-thickness measurement, and its activity was doubled. The resultant thermal activities for a thin detector were consistent with the exponential integral 0.930 $E_2(d\,\Sigma a)$ for a Cd thickness greater than 0.025 cm, where $E_2(\tau) = \int_1^\infty (e^{-\tau x})/(x^2)\,dx$, and a value of 2450 barns was used for the absorption cross section of Cd. (auth)

44717 THE EVEN-ORDER SPHERICAL-HARMONICS METHOD IN CYLINDRICAL GEOMETRY. John O. Mingle (Kansas State Univ., Manhattan). Nucl. Sci. Eng., 20: 324-30(Nov. 1964).

The even-order spherical-harmonics theory for cylindrical geometry is developed along the same lines previously used for slab geometry. In particular an "effective boundary moment" is found such that the common spherical-harmonics approach can be straightforwardly applied. The disadvantage-factor problem for a cylindrical unit cell is used to show the inherent countervergence of the odd- and even-order results when used in this manner. An extrapolation procedure is suggested to overcome the difficulty of divergence for small unit-cell sizes. (auth)

44718 INTERMEDIATE RESONANCE ABSORPTION IN NONHOMOGENEOUS SYSTEMS. Rubin Goldstein (Univ. of California, Berkeley) and Harvey Brooks. Nucl. Sci. Eng., 20: 331-7(Nov. 1964).

The intermediate resonance formulation of slowing-down problems is extended to nonhomogeneous systems by means of formulating the integral transport equation for the problem and comparing with the analogous homogeneous system equations. Heavy-atom slowing down in a heterogeneous system is accounted for in this formulation, yet quite concise expressions for resonance integrals are obtained. Numerical results are compared with a Monte Carlo calculation for a specific lattice; good agreement is obtained. The comparison of homogeneous and nonhomogeneous system equations not only establishes the so-called equivalence relations, but also clearly brings out the approximations involved in these relations and permits a determination of some of the errors involved. In particular, the flat-flux approximation is discussed in detail. (auth)

44719 NON-1/v THERMALIZATION PARAMETERS FOR THE MASS-1 AND NELKIN SCATTERING KERNELS. Gerald P. Calame (Rensselaer Polytechnic Inst., Troy, N. Y.). Nucl. Sci. Eng., 20: 352-7(Nov. 1964).

The asymptotic decay constant for the die-away experiment in which a moderator is poisoned with a non-1/v absorber is expanded as the power series $\lambda = \lambda_0 + N\nu\,[\sigma_{eff} + N(\delta\sigma_{eff})/(\delta N) + \ldots]$, where λ_0 is the decay constant for the unpoisoned moderator and N is the concentration of the non-1/v absorber. The coefficients in the expansion are computed with the Mass-1 and the Nelkin scattering kernels for water poisoned with Cd, Gd and Sm. The computed coefficients $\delta\alpha_{eff}/\delta N$ are in significant disagreement with experimental values; the latter are some five times as large. (auth)

44720 A NOTE ON DELAYED-NEUTRON EFFECTS IN PULSED-NEUTRON MEASUREMENTS ON MULTIPLYING ASSEMBLIES. C. Sastre and E. V. Weinstock (Brookhaven National Lab., Upton, N. Y.). Nucl. Sci. Eng., 20: 359-62 (Nov. 1964). (BNL-7904)

A method of correcting pulsed-neutron measurements for delayed-neutron effects is described. The results of measurements on a ^{235}U-graphite assembly are discussed as an example. (D.C.W.)

44721 SCATTERING OF SLOW NEUTRONS BY A CRYSTAL WITH POINT DEFECTS. J. Peretti and C. Jouanin (EURATOM, Ispra, Italy). Nuovo Cimento (10), 34: 293-302(Oct. 16, 1964).

It was shown that the one-phonon cross section of a harmonic crystal can be related simply to a quantity occurring naturally in the theory of point defects in crystals, that is, the Green function of the defective crystal. This Green function can in principle be calculated without solving the equation of motion of the perturbed crystal, that is, without knowing the polarization vectors and the frequencies belonging to the individual normal modes of the perturbed crystal. The Green function can be evaluated by the perturbation expansion techniques. This constitutes some advantages for the calculation of the neutron cross section over the usual formula given in terms of polarization vectors and frequencies of the normal modes. (C.E.S.)

44722 GREEN'S FUNCTIONS FOR ONE-VELOCITY NEUTRON TRANSPORT IN A ONE-DIMENSIONAL SLAB AND SPHERE. A. Leonard and T. W. Mullikin (Rand Corp., Santa Monica, Calif.). Proc. Natl. Acad. Sci. U. S., 52: 683-8(Sept. 1964).

The computation of a well-defined resolvent or Green's function for one-velocity neutron transport in a one-dimensional slab and sphere is presented. The problem for a slab is treated by considering the transport equation with a certain complex-valued source. It is shown how the resolvent may be expressed simply in terms of the solution to this equation using the Laplace transform and contour deformation. A procedure for computing the complex-valued solution in terms of simple quadratures and rapidly convergent Fredholm equations is subsequently given. Also, the result for the sphere resolvent is given since it is related in a simple manner to the slab resolvent. In particular, the flux resulting from a point source in the center of a sphere is displayed. (P.C.H.)

Nuclear Properties and Reactions

Refer also to abstracts 43932, 44021, and 44426.

44723 (ANL-6800(p.424-8)) NUCLEAR CONSTANTS. D. C. Stupegia (Argonne National Lab., Ill.).

Monoenergetic neutron capture data are reported for Re and Gd for neutron energies between 0.15 and 2 Mev, and neutron total cross sections are given for Re for energies between 2 kev and 2 Mev. Preparations are described for the forthcoming measurement of capture to fission ratios of U and Pu isotopes in EBR-II. (auth)

44724 (AWRE-O-60/64) NEUTRON CROSS SECTIONS OF Li-6 IN THE ENERGY RANGE 0.001 ev–15 Mev. E. D. Pendlebury (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). July 1964. 82p.

Recommended values are given for neutron total and partial cross sections of Li-6 for energies of 0.001 ev to 15 Mev. The available experimental data are supplemented where necessary by estimates based on nuclear theory. Details of energy and angular distributions are given so that the data are complete for the purposes of neutronics calculations. The recommended data given were written on punched cards (3/Li-6 data, nuclide identification number (NIN) = 175) as part of the Aldermaston Nuclear Data Library. A modified data set 3A/Li-6 (NIN = 181), which is perhaps slightly better than the 3/Li-6 data and which can be used as an alternative to it, is referred to in the appendix. (auth)

44725 (AWRE-O-78/64) NEUTRON CROSS SECTIONS OF He-3 IN THE ENERGY RANGE 0.001 ev–14 Mev. 1963 Interim Revision. R. Batchelor and K. Parker (United Kingdom Atomic Energy Authority. Weapons Group. Atomic Weapons Research Establishment, Aldermaston, Berks, England). Aug. 1964. 20p.

Existing (1/He-3 and 2/He-3) data sets for ^{3}He neutron

cross sections underestimate the (n,p) cross section by up to 20% in the range 300 kev to 4 Mev because of the use of incorrectly plotted data from BNL 325 and BNL 325 supplement 1. The report describes a new (3/He-3) data set in which the (n,p) cross section is corrected, and the (n,d) cross section re-evaluated. The total and (n,2n) cross sections have the same values as in previous sets and the elastic cross section of the previous sets is adjusted to give consistency. Angular and energy distribution representations for elastic and (n,2n) secondary neutrons are the same as in the 1/He-3 and 2/He-3 sets. The 2/He-3 values are available on punched cards (nuclide identification number 180) as part of the UKAEA Nuclear Data Library. (auth)

44726 (BNL-325(2nd Ed.)(Suppl.2)(Vol.I)) NEUTRON CROSS SECTIONS. VOLUME I. Z = 1 TO 20. John R. Stehn, Murrey D. Goldberg, Benjamin A. Magurno, and Renate Wiener-Chasman (Brookhaven National Lab., Upton, N. Y.). May 1964. Contract [AT(30-2)-Gen-16]. 252p.

Reference material is arranged by chemical elements and by their isotopes; "thermal" cross sections, resonance parameters, and cross section curves are included. Thermal cross sections include: absorption, (n,γ), (n,p), (n,α), and scattering. Recommended values for cross sections are shown where possible. (R.E.U.)

44727 (BNL-871) COMPUTATION OF THE COEFFICIENTS MULTIPLYING THE INDEPENDENT TWO-PARTICLE RADIAL MATRIX ELEMENTS OF A NUCLEAR HAMILTONIAN. Nazakat Ullah (Brookhaven National Lab., Upton, N. Y.). July 1963. Contract [AT(30-2)-Gen-16]. 9p.

The two-particle matrix element of a nuclear hamiltonian in the basis of jj coupled functions is expressed as a product of certain coefficients and the independent two-particle radial matrix elements. A FORTRAN program for IBM 7090 is described that calculates these coefficients for scalar and tensor potentials. The scalar potentials are taken to be spin independent, spin singlet, and spin triplet. A sample numerical output and a FORTRAN listing are also given. (auth)

44728 (INSJ-71) BAND STRUCTURES IN THE NUCLEAR EXCITED-LEVEL SYSTEM. Mitsuo Sakai (Tokyo Univ. Inst. for Nuclear Study). May 1964. 45p.

Nuclear excited levels were studied by analyzing level-density diagrams. A systematic appearance of two break points in the diagrams is revealed. They may correspond to the energies of the beginning of a band structure and seem to vary smoothly with the mass number. The physical meanings of these break points are discussed in connection with systematic trend of quadrupole one-phonon state, neutron pairing energy, octupole one-phonon state, and so-called Cohen peaks. It turns out that the first break point of even nuclei corresponds to the lowest energy for appearance of two quasi-particle states, while the second break point of even nuclei to a band of negative parity states appearing at the excitation energy 1.3 ~ 1.5 times higher than that of the octupole one-phonon state. These states might be interpreted as a multiplet of quadrupole-octupole two-phonon states. Break points appearing in the diagrams of odd nuclei are also discussed. (auth)

44729 (ISS-64/25) PRELIMINARY RESULTS OF A STUDY OF THE REACTION $C^{12}(e,e'p)B^{11}$ INDUCED BY 550-Mev ELECTRONS. U. Amaldi, Jr., G. Campos Venuti, G. Cortellessa, G. Fronterotta, P. Hillman, A. Reale, and P. Salvadori (Italy. Istituto Superiore di Santia, Rome). June 25, 1964. 5p. (CONF-502-21)

From International Congress of Nuclear Physics, Paris, July 1964.

Preliminary results are presented of an (e,e'p) experiment designed to extend and improve the information on nuclear binding energies and momentum distributions obtained from (p,2p) experiments. For a first experiment, the energies of 550-Mev electrons scattered at 50° from ^{12}C were measured by magnetic deflection, and those of the coincident protons near 110 Mev by range-varying the energies of the incident electrons. The contributions of the 1s and 1p protons to the coincidence rate are clearly seen. (auth)

44730 (KAPL-M-6193) CALCULATION OF THE TIME-DEPENDENT GAMMA-RAY DOSE PRODUCED BY THE DECAY OF THE U^{232} CHAIN. David T. Goldman and Dario Bollacasa (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 26, 1964. Contract W-31-109-eng-52. 12p.

A procedure is given for calculating the gamma dose rate from the $^{232}U-^{208}Pb$ chain using a general depletion computer program. The basic nuclear data used in the calculation is presented. The results are compared with available experimental results and the agreement between the two is quite reasonable. (auth)

44731 (LA-DC-6098) THE SPECTRUM OF EXCITATIONS FOR REAL NUCLEI. J. E. Young (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract [W-7405-eng-36]. 99p.

The many-body problem for finite systems is discussed from a point of view largely that of the intermediate-coupling and configuration-mixing shell models. Emphasis is placed on the determination of excitation spectra for two simple systems, the single-hole system and the single-particle system. It is shown how the spectra for these are obtained by passing from pure independent model to quasi-particle model and thence to representations of the real states. The configuration mixing of the description is generated by allowing for the existence of density correlations in the many-body system. Such correlations manifest themselves as the oscillations of the nuclear surface. Single particle (hole) excitations are altered by the presence of these collective motions. Other, non-collective configurations serving to modify the single-particle spectrum are also discussed. 52 references. (auth)

44732 (MIT-952-1(p.161-2)) NUCLEAR PHYSICS. (Massachusetts Inst. of Tech., Cambridge. Radioactivity Center).

The mean lives of excited rotational states of ^{220}Rn, ^{224}Ra, ^{228}Th, and ^{230}Th were measured by delayed coincidence techniques and data analysis carried out on a 7094 computer. (C.H.)

44733 (NP-14264) RELACION DE SECCIONES EFICACES PARA EL PAR ISOMERICO $Co^{58m/58}$ OBTENIDO POR REACCION (d,t). Informe No. 109. (Relation Between the Effective Cross Section for the Isomer $Co^{58m/58}$ Obtained in the Reaction (d,t). Report No. 109). S. J. Nassiff, M. C. Caracoche, A. Mocoroa, and H. Vignau (Argentina. Comision Nacional de Energia Atomica, Buenos Aires). 1964. 9p.

The cross section ratios for the production of the isomeric pair $^{58m/58}Co$ by the reaction (d,t) was determined for deuteron energies between threshold and 26.0 Mev. (tr-auth)

44734 (NP-14266) RELACION ENTRE LAS SECCIONES EFICACES PARA EL PAR ISOMERICO $Sc^{44m/44}$ FORMADO EN LA REACCION NUCLEAR $[Sc^{45}](d,t)Sc^{44}$. Informe No. 108. (Relation Between the Effective Cross

Section for the Isomers $Sc^{44m/44}$ Formed in the Reaction $Sc^{45}(d,t)Sc^{44}$. Report No. 108). S. J. Nassiff, H. Vignau, M. C. Caracoche, and A. Mocoroa (Argentina. Comision Nacional de Energía Atómica, Buenos Aires). 1964. 7p.

The effective cross section ratios for the formation of ^{44m}Sc and ^{44}Sc in the reaction $^{45}Sc(d,t)$ were measured. The deuteron energy was 26.4 ± 1.2 Mev and the threshold energy for the reaction was studied by means of the stacked foil method. (tr-auth)

4735 (NRL-6124) REGULARITIES IN THERMAL NEUTRON ABSORPTION CROSS SECTIONS. S. Podgor and L. A. Beach (Naval Research Lab., Washington, D. C.). May 25, 1964. 9p. (AD-604195)

Thermal neutron absorption cross sections have generally not been considered to show much systematics. However, some regularities are brought out. Each stable odd Z_i-even N_j nucleus has a higher cross section than the corresponding even (Z_i-1)-even N_j nucleus, with very few exceptions. The odd Z nuclei show a pronounced cyclic variation in cross section, while the corresponding even Z nuclei have considerably less variation. Justifications for these rules are presented on the basis of the existence of a pairing force in the nucleus. Suggestions are given for additional cross section measurements to be made. These involve the determination of cross sections of stable as well as radioactive nuclei. (auth)

4736 (ORNL-3692) CORRELATED ENERGY AND TIME-OF-FLIGHT MEASUREMENTS OF FISSION FRAGMENTS. W. E. Kiker (Oak Ridge National Lab., Tenn.). Oct. 1964. Contract W-7405-eng-26. 94p.

Thesis submitted to Univ. of Tennessee, Knoxville.

The simultaneous measurement of the time-of-flight and the energy of a fission fragment was accomplished using a source of fission fragments placed at one end of an evacuated flight tube so that the fragments must pass through a very thin nickel foil (initial time measurement) before detection by a solid-state device. The resulting timing signals and linear signal, which is proportional to the fragment energy, are recorded in a multichannel correlation analyzer. The time-of-flight apparatus was calibrated by means of heavy ions (^{127}I, ^{79}Br, and ^{81}Br) accelerated to 30 to 100 Mev by a tandem Van de Graaff accelerator. The artifical fission fargments were magnetically separated into velocity groups and allowed to pass through the time-of-flight apparatus. The calibration method, along with a velocity spectrum for spontaneous fission of ^{252}Cf obtained at the same time, provides a universal calibration tool for time-of-flight experiments. Post-neutron kinetics (after emission of prompt neutrons from fission fragments) is considered in detail. (R.E.U.)

44737 (ORNL-TM-930) A COMPUTER PROGRAM FOR OBTAINING NEUTRON AND PROTON INELASTIC-SCATTERING ANGULAR DISTRIBUTIONS USING THE HAUSER-FESHBACH THEORY. William R. Smith (Oak Ridge National Lab., Tenn.). Aug. 1964. Contract W-7405-eng-26. 7p.

A CDC 1604 binary program, which uses a modified Hauser-Feshbach theory, was written and is available from the author on request. The program has for input the spins, parities, and excitation energies of the levels of the target nucleus. The appropriate neutron or proton penetrabilities, which are also part of the input, are obtained from published tables. The program computes the angular distributions and the integrated cross sections for all the levels excited at the bombarding energy employed. Furthermore, provision is made for automatically incrementing the bombarding energy and automatically interpolating the required penetrabilities from the tabular values, so that a large number of cross sections may be computed with a minimum of effort. (auth)

44738 (UCRL-11402) ROTATIONAL STATES PRODUCED IN HEAVY-ION NUCLEAR REACTIONS. F. S. Stephens, N. L. Lark, and R. M. Diamond (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 1964. Contract W-7405-eng-48. 30p.

The de-excitation of the ground state rotational band in nine deformed even-even nuclei of Yb, Hf, and W was observed following heavy-ion nuclear reactions. The transitions from states up to spin 16 (on the average) were observed and their energies were measured with an accuracy of ±0.3%. The rotational spacings thus identified were compared with several calculations, and much the best agreement is obtained with a simplified calculation by Davydov and Chaban taking into account the effects of centrifugal stretching of the nucleus. (auth)

44739 (UCRL-11598) FORMATION OF Be^7 IN He^3-INDUCED NUCLEAR REACTIONS (thesis). Arthur J. Pape (California. Univ., Berkeley. Lawrence Radiation Lab.). Aug. 13, 1964. Contract W-7405-eng-48. 150p.

The importance of the direct-interaction mechanism $^3_2He + ^4_2He$ (cluster) = ^7_4Be for the "alpha-cluster" nucleus ^{12}C and for the ^{27}Al nucleus was studied. The results of the investigation indicate that of a $^{12}C(^3He,^7Be)$ cross section of 57 mb at a ^3He bombarding energy of 31.2 Mev, the direct interaction process has a cross section of approximately one millibarn. The remainder of the ^7Be is formed by compound nucleus type processes of which the $^{12}C(^3He,\alpha_1\alpha_2)^7Be$ mechanism is the most important. Recoil data at lower ^3He bombarding energies were fitted assuming only compound nucleus processes. The results of the $^{27}Al(^3He,^7Be)$ thick-target recoil experiments indicate that at ^3He bombarding energies up to 30 Mev, ^7Be evaporation accounts for approximately 90 percent of the ^7Be production cross section. The other 10 percent is attributed to direct interaction processes. The magnitudes of the direct interaction cross sections for (^3He, ^7Be) and (^4He,^7Be) reactions on aluminum are consistent with the idea that alpha clustering is favored over ^3He clustering in the nuclear surface. (auth)

44740 (UCRL-12033) YIELDS OF COBALT-58 ISOMERS PRODUCED IN HIGH-ENERGY NUCLEAR REACTIONS. Larry D. Miller and John E. Warren (California. Univ., Livermore. Lawrence Radiation Lab.). Aug. 19, 1964. Contract W-7405-eng-48. 23p.

The cross sections for the reactions $^{59}Co(p,pn)^{58m,g}Co$ and $^{59}Co(\alpha,\alpha n)^{58m,g}Co$ were determined in the energy range 276 to 700 Mev for protons and 330 to 880 Mev for alpha particles. The cobalt product was radiochemically separated from the target and determined by means of the characteristic x rays. The cross section was found to decrease from 39 mb at 276 Mev to 36 mb at 700 Mev for ^{58m}Co produced by proton bombardment. The production of ^{58g}Co produced by protons decreased from 73 mb at 276 Mev to 46 mb at 700 Mev. In the alpha irradiations, the production of ^{58m}Co decreased from 94 mb at 330 Mev to 34 mb at 880 Mev. For ^{58g}Co, the cross section was 163 mb at 330 Mev decreasing to 47 mb at 880 Mev. (auth)

44741 CONTRIBUTION TO THE STUDY OF FISSION OF HEAVY NUCLEI AT HIGH ENERGY. Ludwik Kowalski (Faculte des Sciences, Orsay, France). Ann. Phys. (Paris) (13), 9: 211-36(Mar.-Apr. 1964). (In French)

The fission of heavy nuclei was studied using the external 156-Mev proton beam of the Orsay synchrotron. Targets of U, Bi, and Au were chosen in order to compare three dif-

ferent types of fission. After a brief discussion of the experimental method used, the results of the measurements and their interpretation were presented. The cross sections, kinetic energy spectra of the fission fragments, angular distribution of the fragments with respect to the incident beam, and the amount of momentum transferred by the incident protons to the fissioning nuclei were the factors measured. A numerical calculation based on the Monte Carlo method and statistical formulas was attempted in order to calculate the evaporation chains. (J.S.R.)

44742 STUDIES OF THE ELECTRIC QUADRUPOLE INTERACTION WITH THE DIFFERENTIAL ANGULAR CORRELATION METHOD. Martin Salomon, Lennart Bostroem, Torsten Lindqvist, Martha Perez, and Marcus Zwanziger (Uppsala Univ.). Arkiv Fysik, 27: 97-121 (1964).

The interaction between the nuclear quadrupole moment Q and the electric field gradient V_{zz} was studied with the angular correlation method. Both single crystals and polycrystalline sources were investigated, using mainly the time-differential method, but also, in one case, the time-integral method. The general theory related to the experiments reported is reviewed. The equipment is described and several experimental details in the treatment of data, such as accidental coincidences, finite solid angle, source absorption, and finite time resolution, are discussed. Experiments with a Hf single crystal, Hf polycrystalline source at different temperatures, HfO_2, $HfAl_2$, and HfAl are reported. (auth)

44743 A CONVERSION ELECTRON STUDY OF THE DECAY OF Pb^{201}. E. Aasa, T. Sundstroem, O. Bergman, J. Lindskog, and K. Sevier (Uppsala Univ.). Arkiv Fysik, 27: 133-41(1964).

The conversion spectrum associated with the decay of ^{201}Pb to ^{201}Tl was studied using an iron-yoke double-focussing spectrometer. A total of 32 transitions was ascribed to this decay. On the basis of a statistical analysis of sum relationships for the transition energies, combined with coincidence results, a decay scheme involving 21 transitions is suggested. The experimental data indicate a state at 932 kev. Its energy is close to that predicted for an isomeric state corresponding to states observed in other thallium nuclei. (auth)

44744 THE DECAY OF Sb^{125}. K. C. Mann, F. A. Payne, and R. P. Chaturvedi (Univ. of British Columbia, Vancouver). Can. J. Phys., 42: 1700-16(Sept. 1964).

The beta, internal-conversion, and gamma radiations of $^{125}Sb-^{125}Te$ were examined, using magnetic and scintillation spectrometers and beta-gamma and conversion electron-gamma coincidence techniques. The results lead to self-consistent transition intensities and completely support the decay scheme and spin-parity assignments of Narcisi. There is evidence that a considerable fraction of the 633-kev radiation may originate at the 668-kev level. There is also supporting evidence for the 62-kev transition reported by Chandra and Pandharipande. (auth)

44745 STUDIES IN THE DECAY OF THE ACTIVE DEPOSIT OF ACTINIUM. I. ALPHA-GAMMA ANGULAR CORRELATION IN THE DECAY OF Bi^{211}(AcC). C. R. Cothern and R. D. Connor (Univ. of Manitoba, Winnipeg, Can.). Can. J. Phys., 42: 1798-1812(Sept. 1964).

The alpha-gamma angular correlation of the cascade $^{211}Bi(\alpha, 6.27\ Mev)^{207*}Tl(\gamma, 350\ kev)^{207}Tl$ was found to be isotropic to within ±1.5%. Accepting the spin and parity of the ground state of ^{207}Tl as $\frac{1}{2}+$, a search was made for all reasonable spins and angular momenta, pure and mixed, which could yield an isotropic correlation. Shell-model predictions and other situations were examined. No case of unmixed alpha-, unmixed gamma-angular momenta satisfies the isotropy condition. Many other cases are found which do so, but only with the spin and parity of the excited state of ^{207}Tl taken as $\frac{3}{2}+$. It was shown that $\frac{5}{2}+$ does not yield an isotropic correlation. With one radiation mixed and the other pure, there are eight possible combinations which fit the observations. With both radiations mixed, there is an infinity of combinations of the two mixing parameters which lead to an isotropic distribution. The α_k value of the 350-kev transition (0.175 ± 0.017) shows the gamma ray in question to be 76% M1 and 24% E2. The present work is consistent with only one of the two possibilities given by Gorodetzky from polarization-correlation work. Accepting this additional evidence it would appear that the most plausible interpretation is that of shell-model spins and parities with both radiations mixed, alpha — (λ = 3, 5), gamma — (76% M1, 24% E2). (auth)

44746 ON THE FIRST-EXCITED SENIORITY-ZERO SPIN-ZERO STATE IN EVEN-EVEN NUCLEI IN THE PRESENCE OF A PAIRING FORCE. S. Das Gupta (Atomic Energy of Canada, Ltd., Chalk River, Ont.). Can. J. Phys., 42: 1822-6(Sept. 1964). (AECL-2040)

The evaluation of the first-excited seniority-zero state was attempted by the quasi-boson method with moderate success for the cases studied. 27 nuclei were considered. It was concluded that the quasi-boson approximation leads to a more dependable description of the matrix elements than the BCS solutions. (AECL)

44747 A PRECISION MEASUREMENT OF THE ENERGIES OF TRANSITIONS IN Hg^{198} AND Hg^{199}. G. Kaye and R. L. Graham (Atomic Energy of Canada Ltd., Chalk River, Ont.). Can. J. Phys., 42: 1865-70(Oct. 1964).

The energies of the ^{199}Hg 50-, 158-, and 208-kev, and the ^{198}Hg 676- and 1088-kev transitions were measured by comparing the momenta of the internal conversion lines of each transition with three conversion lines of the ^{198}Hg 412-kev transition, the energy of which was previously measured with high accuracy. The comparison was made using the $\pi\sqrt{2}$ beta spectrometer. From the momentum comparisons, the following transition energies were obtained: for ^{199}Hg, 49.828 ± 0.004, 158.370 ± 0.006, and 208.198 ± 0.007 kev; for ^{198}Hg, 675.878 ± 0.018 and 1087.69 ± 0.03 kev. (auth)

44748 MIRROR NUCLEI AND BETA DECAY. M. Vinduška (Inst. of Nuclear Research, Řež, Czechoslovakia). Czech. J. Phys., 14: 477-84(1964). (In Russian)

Experimental properties of mirror nuclei are analyzed. The results permit the improvement of the theory of beta decay. (auth)

44749 THE INFLUENCE OF PRESSURE ON THE MÖSSBAUER EFFECT. J. Dlouhá (Charles Univ., Prague). Czech. J. Phys., 14: 570-9(1964).

A study was made of the pressure dependence of the intensity of the Mössbauer line. The dependence of this quantity on the specific volume of the crystal, which has the same form for all these crystals in the first approximation, was derived for regular atomic crystals in the Grüneisen approximation. The change in intensity of the Mössbauer line due to pressure can be converted, except for a multiplication factor, to a change in intensity of this line caused by a change in temperature. (auth)

44750 THE MÖSSBAUER EFFECT IN THE POINTS OF PHASE TRANSITIONS. J. Dlouhá (Charles Univ., Prague). Czech. J. Phys., 14: 580-5(1964).

The temperature dependence of the intensity of the Mössbauer line, and the shift of its center on passing through the points of phase transitions, was studied. Both quantities exhibit discontinuity at transitions of the first kind, while only the shift of the line center does so at transitions of the second kind. The possibility of using the Mössbauer effect for the exact localization or even classification of phase transitions is shown. (auth)

44751 THE ENERGY DEPOSITION IN A WATER-FILLED SPHERICAL PHANTOM BY SECONDARIES FROM HIGH-ENERGY PROTONS AND BY NEUTRONS. T. V. Blosser, F. C. Maienschein, and R. M. Freestone, Jr. (Oak Ridge National Lab., Tenn.). Health Phys., 10: 743-50 (Oct. 1964).

The energy deposited by neutrons, gamma rays, high-energy protons, and the nuclear secondaries resulting from the interaction of high-energy protons with several targets was measured at various points within a 42-cm-diameter spherical water-filled Lucite phantom. The proton source was the Harvard University Synchrocyclotron, producing protons of nominally 160-Mev energy. Targets were water, aluminum, carbon, copper, and bismuth. For neutrons the $^{3}H(d,n)^{4}He$ reaction, giving ~14.9-Mev neutrons and a Po-Be source ($\bar{E}_n$ = 4.3 Mev) were used. The gamma source was ^{60}Co. The detectors were small Lucite-walled ionization chambers filled with either ethylene or 97% Ar–3% CO_2 gas. Data were taken at the cyclotron both with the phantom on the beam axis and with the phantom offset ~55° from the beam axis. The proton beam energy determined from a part of these results, ~160 Mev, was in good agreement with published values. The energy deposited by secondary particles was found to increase with target-atomic number, as expected. The depth-dose curves had a steeply negative slope over the region near the surface of the phantom and a more gentle slope at greater depths. The magnitude of the dose in the region of the initial slope decreased with increasing target thickness, while the magnitude of the dose at greater depths increased with increasing target thickness. The dose in the region of initial slope was presumably due to secondary protons, while at greater depths the dose was principally controlled by secondary neutron interactions. With an aluminum target thicker than the incident proton range, the absorbed dose at ~55°C from the beam axis was only about 20% of that at 0°C. Comparison of the slopes of the depth dose due to the secondaries (assumed to be largely neutrons) from this target with the slopes obtained with the neutron sources suggested that the effective energy of the secondaries is greater than 15 Mev. (auth)

44752 HALF-LIFE OF Cs^{132}. Philip N. Dean and Chester R. Richmond (Los Alamos Scientific Lab., N. Mex.). Health Phys., 10: 764(Oct. 1964). (LADC-6189)

The half-life of ^{132}Cs was determined to be 6.587 ± 0.005 days as the result of measurements of 0.3 μC of ^{132}Cs in 15 kg H_2O using a whole-body γ counter. (C.H.)

44753 ANGULAR CORRELATIONS OF FRAGMENTS AND LIGHT PARTICLES WITH RESIDUAL NUCLEI. S. A. Azimov, P. A. Gorichev, R. Karimova, and O. V. Lozhkin (Inst. of Nuclear Physics, Academy of Sciences, Uzbek SSR). Izv. Akad. Nauk Uz. SSR, Ser. Fiz. Mat. Nauk, No. 2, 50-5 (1964). (In Russian)

The angular correlations of Z ≥ 4 fragments, α particles, and protons with residual nuclei were studied using a fine-grain emulsion irradiated by 660-Mev protons. An analysis of 437 spallation events for Ag and Br nuclei containing Z ≥ 4 fragments showed that the angular distribution of residual nuclei differs considerably from the angular distribution in ordinary spallations. The angular distributions of recoil nuclei depend also on the directions of the fragments emitted. The angular correlations of protons and α particles with the residual nuclei for spallations with 1 and 2 fragments proved to be (as in the case of stars with fragments of various energies) independent of the number of spallation fragments. (R.V.J.)

44754 THE THERMAL NEUTRON CAPTURE CROSS-SECTION AND RESONANCE CAPTURE INTEGRAL OF ^{125}I. M. Bresesti, A. M. Bresesti Del Turco, H. Neumann, and E. Orvini (C.C.R., Euratom, Ispra, Italy). J. Inorg. Nucl. Chem., 26: 1625-31(Oct. 1964).

The thermal neutron capture cross section of ^{125}I, its resonance capture integral (from 0.5 ev to ∞), and its effective capture cross section in a reflector position of the Ispra 1 reactor were found to be 894 ± 90, 13730 ± 2000, and 991 ± 100 barns, respectively. These values were determined by irradiating targets of ^{125}I and measuring the activity of ^{126}I produced by the (n,γ) reaction. The value of the resonance integral was presumably the highest ever determined for (n,γ) reactions. Irradiations made with different thicknesses of cadmium cover showed the absence of a major resonance in the region of the cadmium cutoff. (auth)

44755 PRODUCTION OF THE ISOTOPES 196 TO 202 OF POLONIUM BY THE NUCLEAR REACTIONS (p,xn) ON BISMUTH. C. Brun and M. Lefort (Université de Paris, Orsay, France). J. Inorg. Nucl. Chem., 26: 1633-8 (Oct. 1964). (In French)

Excitation functions were measured for the production of polonium isotopes 202, 201, 200, 199, 198, 197, and 196 when bismuth targets were bombarded by protons in the energy range 80 to 155 Mev. A fast chemical separation by polonium deposition onto silver plates made the measurements possible for the shortest half life of 1.7 min. The unknown α branching ratio was estimated and values are given for half lives. The results on cross sections measurements were compared with Monte Carlo calculations made with the "two-step process" assumption. (auth)

44756 RADIOCHEMICAL STUDIES OF CHARGE AND MASS DISTRIBUTION IN THE LIGHT FRAGMENT REGION IN FISSION OF URANIUM INDUCED BY 170 Mev PROTONS. E. Hageboe, A. C. Pappas, and P. Aagaard (Uppsala Univ., and Oslo Univ.). J. Inorg. Nucl. Chem. 26: 1639-52(Oct. 1964).

Cumulative and independent yields were measured for fission products in the mass range 64 to 98 in the fission of natural uranium induced by 170-Mev protons. The yields were used to evaluate the mass and charge distribution in this region. The charge distribution curve seemed narrow and the n/p ratio for the most probable fragment in a given mass chain increased with mass number. Some consequences of these findings are discussed. Support was found for the existence of an isomer in ^{96}Nb and previous indications of an isomer in ^{98}Nb were confirmed. (auth)

44757 ELASTIC SCATTERING OF ALPHA PARTICLES FROM Al^{27}. Mujaddid A. Ijaz, P. B. Weiss, R. H. Davis, and Razia Ijaz (Florida State Univ., Tallahassee). J. Nat. Sci. Math., 4: 1-14(Apr. 1964).

The Tandem Van de Graaff alpha beam is used to explore the reaction ^{27}Al. The differential cross section for the elastic scattering of alpha particles from natural aluminum targets (150 kev thick to 10 Mev alpha particles) was measured for incident alpha particles energies between 7 and 19.00 Mev at laboratory angles of 81.7, 118.5, 135.0, and

158.0 degrees. Throughout this energy region these excitation curves display many unresolved resonances and some broad structures. Nine angular distributions were measured in this energy range. The principle feature of these angular distributions was their moderate backward peaking, the cross section rising to ten times that of Rutherford scattering at 170° Lab. The shapes of the excitation curves and angular distributions differ markedly from those taken on the neighboring nucleus ^{28}Si which display many strong resonances in the excitation function and pronounced diffraction patterns in the angular distributions. Optical model analysis of the data was carried out and some of the fits to angular distributions made by the use of optical parameters is included. (auth)

44758 EMISSION OF Li^8 FROM HIGHLY EXCITED NUCLEI. S. A. Durrani (Atomic Energy Centre, Lahore). J. Nat. Sci. Math., 4: 15-31(Apr. 1964).

The hammer tracks (^{8}Li breaking up into 2 α particles via ^{8*}Be) produced in nuclear emulsion by a 4.5-Bev π-beam were examined. The purpose was to study the mechanism of ejection of large fragments from highly excited nuclei; to deduce the transition level in ^{8}Be; and to determine, if possible, the β-interaction involved in ^{8}Li decay. A composite model based on the evaporation theory of Le Couteur together with some knock-on ejection is proposed. The ^{8}Be level is found to be a broad level at 2.9 Mev (Γ = 1.8 Mev). Nuclear emulsion techniques are found to be too imprecise to distinguish between the different β-couplings. The case of anomalous events where no decay electron was found is considered in some detail. (auth)

44759 OBSERVATION OF A DOUBLE $\Sigma^+\Lambda^0$ HYPERFRAGMENT. B. Ahmad, J. Ahmad, M. Ashraf, J. Aslam, A. Ghani, G. Hussain, and A. G. Rehmatullah (Atomic Energy Centre, Lahore). J. Natl. Sci. Math., 4: 51-5(Apr. 1964).

During a systematic scan of 3-Bev/c antiproton interactions in nuclear emulsion, an event was found which can be interpreted in terms of the formation of a double hyperfragment involving the trapping of a $(\Sigma^+\Lambda^0)$ pair in a single nucleus. Various other interpretations are discussed and discarded on the basis of kinematic considerations applied to the production and decay processes at different vertices. On the basis of decay of the single and double hyperfragments, the double hypernucleus is identified to be $_{\Sigma^+\Lambda^0}$ Be^5. (auth)

44760 ELASTIC SCATTERING OF NEUTRONS BY HEAVY NUCLEI. Khaleda Begum, A. L. Chowdhury, A. K. Rafiqullah, and D. Hossain (Univ. of Dacca, East Pakistan). J. Nat. Sci. Math., 4: 57-64(Apr. 1964).

A many-level formula for the elastic scattering cross section is examined using Kapur-Peierls formalism by matching the logarithmic derivative of a compound-nuclear level wave function at the nuclear surface. The Breit-Wigner one-level formula is derived as a special case. An attempt was made to establish a relation between this resonance theory and the optical model. Some numerical calculations were also performed using the many-level and single-level formulas. (auth)

44761 $C^{12}(He^3,\alpha)C^{11}$ REACTION AT 29.4 ± 0.1 Mev. A. S. Chohan (Government Coll., Lahore). J. Nat. Sci. Math., 4: 65-70(Apr. 1964).

The reaction was studied by the angular distribution of the recoil particle ^{11}C. The reaction is found to proceed via a pick-up process both by normal and heavy particle stripping. The distribution was fitted with Butler's stripping theory using Bessel function values for l = 1 and interaction radius 4×10^{-13} cm. (auth)

44762 DEUTERON STRIPPING AND PICK-UP REACTIONS. M. G. Mustafa, D. Husain, A. K. Rafiqullah, and A. L. Choudhury (Univ. of Dacca, East Pakistan). J. Nat. Sci. Math., 4: 81-6(Apr. 1964).

Angular distributions of protons from $^{12}C(d,p)^{13}C$ stripping reaction corresponding to the ground state of ^{13}C is calculated for 13.3-Mev deuterons by cut-off Born approximation method of Butler, for both zero and finite ranges of the n-p interaction potential. A comparison with the experiment is made for both ranges, individually and very good fit is observed at small angles. A calculation of the angular distributions, following the same method, is also made for the $^{16}O(n,d)^{15}N$—pick-up reaction for the ground state of ^{16}O for 15-Mev, neutrons for both zero and finite ranges. No comparison with the experiment is made, since experimental works are not available at present. (auth)

44763 CROSS SECTION FOR THE REACTION $^{238}U(n,\gamma)^{239}U$ IN THE ENERGY RANGE 0.12–7.6 Mev. J. F. Barry, J. Bunce, and P. H. White (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Nucl. Energy, Pts. A & B, 18: 481-9(Sept. 1964).

The cross section of the reaction $^{238}U(n,\gamma)^{239}U$ was measured in the neutron energy range 0.12 to 7.6 Mev. Neptunium-239 from the decay of ^{239}U was chemically extracted and counted to determine the reaction rate. The neutron flux was measured relative to the neutron–proton scattering cross section. The results obtained generally had an accuracy of 5 per cent, and help to decide between conflicting results in some energy regions. (auth)

44764 THE RADIATIVE CAPTURE CROSS SECTION OF ^{197}Au FOR NEUTRONS IN THE ENERGY RANGE 0.12-1.8 Mev. J. F. Barry (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). J. Nucl. Energy, Pts. A & B, 18: 491-6(Sept. 1964).

The cross section for the reaction $^{197}Au(n,\gamma)^{198}Au$ was measured in the neutron energy range 0.12 to 1.8 Mev. Gold-198 produced in the reaction was determined with a γ-ray detector calibrated with a β–γ coincidence counter and a $4\pi\beta$ counter. The neutron flux was measured in terms of the n–p scattering cross section. (auth)

44765 MEASUREMENT AND CALCULATION OF RECOIL RANGES OF ^{27}Mg AND ^{24}Na IN THE REACTIONS $^{27}Al(n,p)^{27}Mg$ AND $^{27}Al(n,\alpha)^{24}Na$. Hidehiko Mitsui (Hitachi Ltd., [Tokyo]). J. Nucl. Sci. Technol. (Tokyo), 1: 203-9 (Sept. 1964).

Since aluminum is widely used in reactor construction, the recoil ranges of ^{27}Mg and ^{24}Na produced by the (n,p) and (n,α) reactions play an important part in evaluating the amount of activity in the coolant of swimming pool type reactors. These recoil ranges however do not seem so far to have been studied in any great detail. Acrylic acid resin vessels containing aluminum sheets immersed in water were irradiated in the H.T.R. (Hitachi Training Reactor), after which the activity from the water was measured by β-γ coincidence. Background activity was determined by preparing blank water samples in which aluminum sheets were soaked for the same time interval without irradiation. Argon-41 activity was corrected by taking the decay curves from each of the coincidence channels. Aluminum foils were also irradiated dry and counted to determine the reaction rate. Recoil ranges of ^{27}Mg and ^{24}Na thus determined were 4.18×10^{-5} cm and 1.37×10^{-4} cm respectively, which agreed well with calculated values. (auth)

44766 STUDY OF PARTICLE TRACKS INDUCED BY PROTON INTERACTIONS AT 3 Gev IN DIFFERENT MINERALS. M. Maurette and R. M. Walker (Universite de

Paris, Orsay, France). J. Phys. (Paris), 25: 661-6(June 1964). (In French)

An optical microscope study of heavy particle tracks induced by 3-Bev proton interactions in samples of mica, tektite, and olivine is presented. The results are used to specify the conditions under which it should be possible to observe cosmic ray interactions in natural samples of these minerals. A new method of estimating cosmic ray exposure ages of tektites is also proposed. (auth)

44767 FORM FACTORS FOR β SPECTRA OF ^{114}In AND ^{90}Y. S. Andrê and P. Depommier (Université, Grenoble, France). J. Phys. (Paris), 25: 673-7(June 1964). (In French)

The β spectra of ^{114}In and ^{90}Y were measured by means of an intermediate image spectrometer. The spectrum of ^{114}In exhibits the allowed shape within ±0.5%; for ^{90}Y, however, a deviation from the unique shape was found, a term $1 + b/E$ with $b = (26 \pm 3)\ 10^{-2}\ mc^2$ fitting the results. (auth)

44768 A METHOD FOR STUDY OF ELASTIC SCATTERING (n,p), (n,d), (n,t) AND (n,α) BY DETECTION OF RECOIL IONS IN A SCINTILLATION COUNTER. Daniel Blanc, Francis Cambou, Gilbert Vedrenne, and Rémy Arcangeli (Faculté des Sciences, Toulouse). J. Phys. (Paris), 25: 678-82(June 1964). (In French)

Differential elastic scattering cross sections for 14-Mev neutrons on p, d, t, and α nuclei can be studied by introducing the scatterer in the scintillation counter or by putting a small layer of this scatterer on a mineral scintillator. Several corrections have to be applied to pulse height distributions when the differential elastic cross section is deducted from the experimental spectrum of recoiling particles. The experimental conditions of the (n,d) elastic scattering study show that the chief cause of distorsion arises from the poor resolution of the liquid scintillator used. A complete computation on an IBM 650 computer allowed us to obtain the (n,d) differential elastic scattering cross section. (auth)

44769 ANALYSIS OF ELECTRIC DIPOLE TRANSITIONS IN UNEVEN NUCLEI IN THE RARE-EARTH REGION. G. Monsonego and R. Piepenbring (Université, Strasbourg). J. Phys. (Paris), 25: 691-5(June 1964). (In French)

A qualitative study of E_1 transitions in the rare-earth region for odd A nuclei is presented. The theoretical transition probability in Nilsson's scheme with neutron and proton effective charge is calculated. When pairing forces are taken into account, a reduction factor is obtained. This factor does not explain all the transitions. (auth)

44770 EXCITATION FUNCTIONS OF (p,pn) AND (p,2p2n) REACTIONS IN LIGHT NUCLEI BETWEEN 15 AND 155 Mev. L. Valentin, G. Albouy, J. P. Cohen, and M. Gusakow (Universite de Paris, Orsay, France). J. Phys. (Paris), 25: 704-6(June 1964). (In French)

The excitation function of the reaction $^{14}N(p,pn)^{13}N$ was measured. The order of magnitude of the cross section shows the effect of the number of available neutrons. The shape of the excitation function seems to show the influence of the binding energy of these neutrons. The excitation functions of the reactions (p,2p2n) on ^{10}B and ^{14}N are given. The possibility of the reactions (p,pt) and (p,α) is considered. (auth)

44771 DESCRIPTION OF A NUCLEAR RESONANCE EXPERIMENT SENSITIVE TO CONTINUOUS TRANSVERSE FIELDS. H. Benoit, J. F. Delpech, P. Grivet, and E. Varoquaux (Université de Paris, Orsay, France). J. Phys. (Paris), 25: 707-12(June 1964). (In French)

An experiment on a nuclear magnetic resonance gyroscope with enhanced sensitivity through prepolarization is described. Theoretical predictions, from Bloch's equations in low magnetic fields, shows that one may expect many resonances corresponding to one or more electromagnetic quanta. Each of these resonances gives a nonsinusoidal signal, and the second harmonic of this signal is detected. With this apparatus a sensitivity better than 1 mG for transverse magnetic fields was obtained. (auth)

44772 RESEARCH ON THE REACTION (γ,2n) ON OXYGEN-16 BOMBARDED BY PHOTONS AT 31 Mev. Y. Moriceau and A. Bertin (Commissariat à l'Energie Atomique, [Saclay, France]). J. Phys. (Paris), 25: Suppl. to No. 6, 129A-30A(June 1964). (In French)

A very sensitive technique was used to determine the 28.9-Mev photoneutron threshold of the $^{16}O(\gamma,2n)\ ^{14}O$ process. The (γ,γ) coincidence method is described. An application was made to the energy calibration of a betatron. (auth)

44773 MOLECULAR ORBITAL THEORY OF NUCLEAR SPIN COUPLING CONSTANTS. J. A. Pople and D. P. Santry (National Physical Lab., Teddington, Eng.). Mol. Phys., 8: 1-18(1964).

Molecular orbital theory in the LCAO form is used in a study of the indirect coupling between nuclear spins through the electronic environment. By retaining only the largest one-center integrals, approximate formulas involving the LCAO coefficients are derived for the three contributions due to the electron orbital effect, the dipolar interaction between nuclear and electron spins, and the Fermi contact effect. The theory is then applied in detail to the coupling between directly bonded atoms, when the contact term is usually dominant. Approximate calculations indicate that the reduced coupling constant K_{AB} (defined as $(2\pi/\hbar\gamma_A\gamma_B)J_{AB}$, where γ_A and γ_B are the nuclear magnetogyric ratios and J_{AB} is the usual constant in cycles/second) is negative if one of the atoms is fluorine. Broad agreement is obtained with the available experimental data for atoms up to fluorine connected by single bonds and a tentative pattern for signs and magnitudes is suggested. (auth)

44774 FISSION OF URANIUM, THORIUM AND BISMUTH BY 20 Gev PROTONS. G. Cortini (Istituto Nazionale di Fisica Nucleare, Naples and Università, Naples), M. Muchnik, G. Potenza, R. Rinzivillo, W. O. Lock, and H. G. de Carvalho. Notas Fiz., Centro Brasil. Pesquisas Fis., 9: 257-66(1962).

The cross sections for the proton-induced fission of Bi, Th, and U were measured at proton energies of 20 and 21.8 Bev. The cross sections were smaller than at 600 Mev by a factor of 3 to 4, while the ratios of the cross sections of the various elements remained approximately constant in the same energy interval. (auth)

44775 NEUTRON YIELDS FROM PROTON BOMBARDMENT OF THICK TARGETS. R. R. Borchers, J. C. Overley, and R. M. Wood (Univ. of Wisconsin, Madison). Nucl. Instr. Methods, 30: 73-6(Nov. 1964). (COO-7-329)

The neutron spectra and relative gamma yields in proton bombardment of thick targets of C, H_2O (ice), Mg, Si, S, CaO, ^{58}Ni, Ta, W, Pt, Au and Pb at proton energies from 8 to 13 Mev were measured to obtain information on the relative merit of these materials as beam stops. The neutron spectra were integrated to obtain the total yield of neutrons with energies greater than 0.7 Mev. For proton energies below 10 Mev, the ^{58}Ni target produced the lowest yield of neutrons; but the gamma yield was relatively high. At proton energies above 11 Mev, ice had the lowest neutron yield; and the gamma yield was lower than that produced by the ^{58}Ni target. (auth)

44776 MULTIPLE SCATTER CORRECTIONS USING THE MONTE CARLO PROGRAM MAGGIE. J. B. Parker, J. H. Towle, D. Sams, W. B. Gilboy, A. D. Purnell, and H. J. Stevens (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Instr. Methods, 30: 77-87(Nov. 1964).

The Monte Carlo program MAGGIE, which corrects measurements of neutron scattering cross sections for the effects of multiple scatter, flux attenuation, and the angular spread of neutrons incident on a cylindrical sample, is described; and the various facilities in the program and its use are illustrated by examples. The neutron energy spectrum for each detector position is calculated by the program. (auth)

44777 INELASTIC SCATTERING OF NEUTRONS FROM MEDIUM AND HEAVY NUCLEI. S. G. Buccino, C. E. Hollandsworth, H. W. Lewis, and P. R. Bevington (Duke Univ., Durham, N. C.). Nucl. Phys., 60: 17-34 (Nov. 1964).

The energy spectra of neutrons scattered inelastically from 23 medium and heavy elements from Zr to U were observed at 90° for incident energies of 4.0, 5.0, 6.0 and 6.5 Mev, using time-of-flight techniques. The Fermi gas model, with constant level density coefficient, describes the data reasonably well for nuclei between closed shells when pairing energy corrections are made. For nuclei near the shell closures at N = 82, Z = 82 and N = 126, the nuclear temperatures are nearly constant over the range of excitation energies studied, and therefore the level density coefficients increase with excitation energy. There is a general agreement between the experimentally determined values of the Fermi gas model level density coefficient and theoretical predictions, although the overall increase of level density coefficient with mass number does not appear to be as great as predicted by a simplified equidistant-spacing model. (auth)

44778 THE REACTIONS $Rh^{103}(p,d)Rh^{102}$ AND $Rh^{103}(p,t)Rh^{101}$ AT 16.8 Mev. Kip S. Thorne and Edwin Kashy (Princeton Univ., N. J.). Nucl. Phys., 60: 35-48(Nov. 1964). (PUC-1964-143)

The reactions $^{103}Rh(p,d)^{102}Rh$ and $^{103}Rh(p,t)^{101}Rh$ were investigated, using 16.8-Mev protons. The Q values for the two reactions were determined to be -7.144 ± 0.016 and 8.275 ± 0.017 Mev, respectively. Excited levels of ^{101}Rh were observed at 331, 869, 1041, and 1512 kev. The 331-kev level may be the 4.5 d isomer of ^{101}Rh. Excited levels of ^{102}Rh were observed at 76, 161, 291, 380, 491, 544, 680, 726, 1200, 1670, and 1840 kev. Angular distributions were measured for most of the levels; and, from the comparison of these distributions with distorted-wave Born approximation calculations and with each other, conclusions were drawn about the spin, parity and spectroscopic factors of some of the levels. (auth)

44779 TRENDS IN NUCLEAR REACTION CROSS SECTIONS. III. THE (n,α) REACTION INDUCED BY 14.5 Mev NEUTRONS FOR ELEMENTS IN THE RANGE $6 \leq Z \leq 30$. Donald G. Gardner and Yu-wen Yu (Illinois Inst. of Tech., Chicago). Nucl. Phys., 60: 49-65(Nov. 1964).

An equation previously derived for the relative cross sections of the isotopes of a given element on the basis of the statistical model is rederived, including the effective Coulomb barrier for the emitted particle. The relative (n,α) cross section for 14.5-Mev neutrons is calculated for several isotopes of every element with $6 \leq Z \leq 30$. An empirical equation is also presented which predicts rather well the absolute (n,α) cross sections for the isotopes. (D.C.W.)

44780 INTERPRETATION OF ISOMER RATIOS IN NUCLEAR REACTIONS WITH FERMI-GAS AND SUPERCONDUCTOR MODELS. H. K. Vonach, R. Vandenbosch, and J. R. Huizenga (Argonne National Lab., Ill.). Nucl. Phys., 60: 70-96(Nov. 1964).

Nuclear temperatures and isomer ratios are calculated on the basis of a semiquantitative theory for a Fermi gas with pairing correlations analogous to those of a superconducting metal. Although the superconductor model predicts only a slight energy dependence of the nuclear temperature at low-excitation energies, in agreement with some, but not all experimental results, the single-particle level spacings required to reproduce the absolute values of the experimental nuclear temperatures are considerably smaller than expected. The superconductor model predicts a reduction from the rigid-body moment of inertia which is consistent with isomer ratios for nuclei with an odd number of nucleons. However, some evidence is presented to show that the superconductor model overestimates the reduction in the moment of inertia for odd nuclei. Nuclear temperatures and isomer ratios are also calculated with a shifted Fermi gas model. In this model the Fermi gas predictions are modified to compensate for pairing interactions by simply re-defining excitation energies relative to a characteristic level. The characteristic level of an odd nucleus is assumed to be identical with its ground state. For odd nuclei the experimental isomer ratios are in good agreement with predictions of the Fermi gas theory with a rigid body moment of inertia. The shifted Fermi gas model gives better agreement with nuclear temperatures than the superconductor model, but gives too large a moment of inertia for odd-mass nuclei. The agreement between the predictions of the superconductor theory and the various experimental data for all types of nuclei is unimproved over the simpler Fermi gas theory. (auth)

44781 A SEARCH FOR THE CHARGE-DEPENDENT NUCLEAR FORCES. Ljubisav Novaković (Inst. for Nuclear Sciences "Boris Kidric," Belgrade). Nucl. Phys., 60: 161-8(Nov. 1964).

It is shown that a possible deviation from charge independence, which the nuclear forces may exhibit, is sensitive to the size parameter appearing in a single-particle nuclear wave function. This parameter was fitted from the charge density distributions obtained from scattering experiments on ^{24}Mg using 187-Mev electrons. The measured atomic $^{24}Al - ^{24}Na$ mass difference was calculated by taking into account not only electrostatic and electromagnetic effects but also those effects coming from a charge-dependent internucleon potential. The Fermi matrix element for the beta decay branches $(^{24}Al, ^{24}Na) \rightarrow ^{24}Mg$ was reanalyzed. The results indicate that the nuclear forces depart from the exact charge symmetry (pp = nn) by approximately 0.5%. (auth)

44782 CHARGE DEPENDENT POTENTIALS AND NEUTRON-NEUTRON SCATTERING LENGTH. D. L. Lin (Yale Univ., New Haven). Nucl. Phys., 60: 192-202(Nov. 1964).

Nuclear charge-dependent potentials of the Brueckner and Watson type are obtained by inserting different masses of the charged and neutral pions. The pair formation terms are completely suppressed following the work of Klein. These potentials are then used to calculate the charge dependence of the ^1S scattering lengths a_{np} and a_{pp} and the energy difference of the first T = 1 state of ^6Li and ^6He. The three coupling constants for π-N systems and the hard core radius are treated as open parameters to be fixed by empirical data. It is found that the coupling constants are

very close to one another, except for a small deviation from charge symmetry. By use of the coupling constants thus obtained the scattering length for the neutron-neutron system in a ^1S state is calculated. The results are compared with a recent measurement, and satisfactory agreement is obtained. (auth)

44783 A NOTE ON THE PAIRING INTERACTION IN NUCLEI. Y. Nogami and I. J. Zucker (Battersea Coll. of Tech., London). Nucl. Phys., 60: 203-8(Nov. 1964).

A method was developed for treating the pairing interaction in nuclei by using a model Hamiltonian $H-\lambda_1 N-\lambda_2 N^2$, where H is the original Hamiltonian and N is the nucleon number operator. This method is applied to several examples, and its accuracy is discussed. (auth)

44784 THE DECAY OF MERCURY-190. Jerzy Jastrzebski and Pierrette Kilcher (Université Paris, Orsay, France). Nucl. Phys., 60: 222-37(Nov. 1964). (In French)

The excited states of ^{190}Au were studied by observing the decay of isotopically separated ^{190}Hg, using beta and gamma scintillation techniques. The energy level schemes of ^{190}Au and ^{192}Au were compared. (D.C.W.)

44785 TREATMENT OF NEUTRON-PROTON CORRELATIONS. Amit Goswami (Saha Inst. of Nuclear Physics, Calcutta and Western Reserve Univ., Cleveland). Nucl. Phys., 60: 228-40(Nov. 1964).

A canonical quasiparticle transformation is derived by the linearization method of Anderson, Valatin and Pal for the case of nuclei in which neutron and proton simultaneously fill the oscillator shells. The proposed method treats the J = 0 (short-range) part of the n-p interaction on the same footing as the J = 0 part of n-n and p-p interaction. The energy gap is shown to arise from the J = 0 part of n-n, p-p and n-p force. Since each angular momentum state can now be occupied both by neutron and proton, the quasiparticles introduced in this method are linear combinations of proton hole and particle and neutron hole and particle. Such a transformation does not conserve the z component T_z of isobaric spin, but since this is given by $\frac{1}{2}$ (neutron number N − proton number Z), violation of this conservation law is on the same footing as that of violation of particle number conservation. For N = Z nuclei, the method does not apply as such. However, a quasiparticle transformation based on the strict isobaric-spin conservation in this case is proposed, which can possibly account for the energy gap of these nuclei. (auth)

44786 ISOMER RATIOS FOR SOME (n,γ) REACTIONS. C. T. Bishop, H. K. Vonach, and J. R. Huizenga (Argonne National Lab., Ill.). Nucl. Phys., 60: 241-9(Nov. 1964).

Isomer ratios were measured for capture of thermal and epi-cadmium neutrons by ^{80}Se, ^{103}Rh, ^{108}Pd, ^{128}Te and ^{133}Cs. The experimental values and all similar data in the literature are compared with a Fermi gas theory. In general the agreement between theory and experiment is satisfactory, although a number of individual discrepancies do exist. (auth)

44787 EXPLICIT POLYNOMIAL EXPRESSIONS FOR FINITE ROTATION OPERATORS. R. van Wageningen (Afdeling voor Theoretische Natuurkunde, Groningen, Netherlands). Nucl. Phys., 60: 250-63(Nov. 1964).

The operator for a finite rotation about a certain direction n can, in the (2j + 1)-dimensional irreducible representation, be written as a polynomial of degree 2j in the component J = J · n of the angular momentum operator J along this direction. Explicit expressions for the expansion coefficients are derived. (auth)

44788 STUDIES OF ALPHA PARTICLE GROUPS FROM THE $P^{31}(d,\alpha)Si^{29}$ REACTION IN THE DEUTERON ENERGY RANGE BETWEEN 1.5 AND 2.5 Mev. M. A. Abuzeid, A. T. Baranik, M. I. El-Zaiki, V. J. Gontchar, S. M. Morsy, and I. I. Zaloubovsky (Atomic Energy Establishment, Cario). Nucl. Phys., 60: 264-72(Nov. 1964).

The excitation functions for five groups of alpha particles from the $^{31}P(d,\alpha)^{29}Si$ reaction were measured at a laboratory angle of 150° in the deuteron energy range from 1.0 to 2.5 Mev. For each group a number of resonances was observed. Angular distributions were measured at angles from 75 to 150° for certain resonance energies and for those between the resonances. These angular distributions prove that reaction proceeds mainly by compound nucleus formation. The relative intensities of the alpha particle groups outside the resonances were found to follow the 2I + 1 rule (I is the spin of the residual nucleus). (auth)

44789 SHELL EFFECTS IN 14 Mev (n,p) REACTIONS. Aparesh Chatterjee (Saha Inst. of Nuclear Physics, Calcutta). Nucl. Phys., 60: 273-93(Nov. 1964).

The available experimental data on the 14-Mev total (n,p) reaction cross sections were updated for the most abundant elements and were reanalyzed. Marked proton shell and subshell effects and pairing effects were noted. A convenient shell-dependent form of the statistical level density was developed by using the simple Bloch-Rosenzweig model of combinatorial nuclear structure. This form was used to estimate quantitatively the observed shell and subshell effects. 55 references. (auth)

44790 THE DECAY OF 2.2h ^{138}Pr AND EXCITED STATES IN ^{138}Ce. Manabu Fujioka, Kazuo Hisatake, and Kaoru Takahashi (Tokyo Inst. of Tech.). Nucl. Phys., 60: 294-304(Nov. 1964).

The decay of 2.2-hr ^{138}Pr was studied, using NaI(Tl) scintillation spectrometers and a magnetic beta spectrometer. The energies (Mev) and relative intensities (indicated in parentheses) of the observed gamma rays were 0.298(77), 0.40(9), 0.51(61) (annihilation radiation), 0.55(≈5), 0.788 (100), 1.035(100), 1.2(≈1) and 1.83(≈0.4). The 0.298-Mev transition was determined to be E3 from the K/LM ratio and the K conversion coefficient, and the multipolarity of the 1.035 Mev transition was determined to be E2 from the K conversion coefficient. From gamma-gamma angular correlation and internal conversion measurements, the spins and parities of the second and the third levels of ^{138}Ce were determined to be $1.823(4^+)$ and $2.121(7^-)$, respectively. A level at 2.22 Mev was proposed from gamma-gamma coincidences. The ^{138}Pr positrons were found mainly (92% per decay including electron capture) to feed the 2.121-Mev state with a maximum energy of 1.65 ± 0.02 Mev. Thus, the log ft value was found to be 5.7 ± 0.1. The spin and parity of the 2.2-hr ^{138}Pr, which are assigned to be 7^-, 8^- or 6^-, are discussed, together with the $7^- \rightarrow 4^+$ E3 transition. (auth)

44791 DIRECT REACTION OF NUCLEON CLUSTER SUBSTITUTION AND CLUSTER STRUCTURE OF LIGHT NUCLEI. P. Beregi (Moscow State Univ.), V. G. Neudatchin, and Yu. F. Smirnov. Nucl. Phys., 60: 305-12(Nov. 1964).

It is shown that a large difference between the cross sections of the direct reactions $^{12}C(t,\alpha)^{11}B$ and $^{13}C(^3He,\alpha)^{12}C$ is caused by surface interference effects in the amplitude of cluster substitution reactions. In the case of the $^{12}C(t,\alpha)^{11}B$ reaction, this interference is constructive, but in the case of the $^{13}C(^3He,\alpha)^{12}C$ reaction, it is destructive.

A program of experimental investigations is briefly outlined. (auth)

44792 STUDY OF CHROMIUM-52 BY INELASTIC ELECTRON SCATTERING. J. Bellicard (CEN, Saclay, France), P. Barreau, and D. Blum. Nucl. Phys., 60: 319-36(Nov. 1964).

The inelastic scattering of electrons at 150 to 180 Mev from ^{52}Cr was observed. Electric transitions with L = 2, 3, 4 were identified. By comparison of the reduced transition probabilities B(EL) with corresponding single-particle estimates B_{sp}, the collective character of the 1.43-Mev E2 transition ($G_2 = B(E2)/B_{sp} = 9.25 \pm 0.75$); of two E4 transitions at 2.37 Mev ($G_4 = 3.4 \pm 0.6$) and at 2.97 Mev ($G_4 = 2.5 \pm 0.35$); and of five E3 transitions at 4.6 Mev ($G_3 = 6.10 \pm 0.30$), 6.6 Mev ($G_3 = 2 \pm 0.24$), 7.1 Mev ($G_3 = 2.4 \pm 0.24$), 7.9 Mev ($G_3 = 2.4 \pm 0.24$) and 8.6 Mev ($G_3 = 2 \pm 0.24$) was established. At low momentum transfer ($q \leq 0.8$ fm^{-1}), the excitation of three levels at 2.65, 3.16 and 3.78 Mev was obtained. Within the framework of the incompressible liquid drop model suggested by Walecka, the possibility of considering the 2.65- and 3.16-Mev levels as the 0^+ and 2^+ two-surfon quadrupole states was considered. (auth)

44793 THE PHOTODISINTEGRATION OF MOLYBDENUM. R. W. Gellie and K. H. Lokan (Univ. of Melbourne). Nucl. Phys., 60: 343-8(Nov. 1964).

The cross sections for the reactions $^{100}Mo(\gamma,n + \gamma,p)$, $^{98}Mo(\gamma,np)$, $^{98}Mo(\gamma,p)$, $^{97}Mo(\gamma,p)$, $^{92}Mo(\gamma,n)$ and $^{92}Mo(\gamma,2n + \gamma,np)$ were determined by activation methods for photon energies up to 33 Mev. The photoproton cross section, which exhibits a maximum at 21 Mev, accounts for some 10% of the total absorption and is about equal to the sum of the cross sections for the measured multiple reactions. The results are discussed in terms of competition between direct nucleon emission and the formation of a compound nucleus, and it is argued that the high proton yield arises from transitions between shell-model states of low angular momentum. The data are consistent with the existence of an E1 "overtone" in the region above 20 Mev. (auth)

44794 GAMMA RAYS FROM THE INTERACTION OF 14 Mev NEUTRONS WITH C^{12} AND Mg^{24}. D. T. Steward and P. W. Martin (Univ. of Glasgow). Nucl. Phys., 60: 349-52(Nov. 1964).

The gamma rays following the inelastic scattering of 14.1-Mev neutrons were measured using the associated-particle technique. The differential cross sections for the production of 4.43-Mev gamma rays from ^{12}C and 1.37-Mev gamma rays from ^{24}Mg were determined. (auth)

44795 PROTON-He^4 SCATTERING AT 53 Mev. D. J. Cairns, T. C. Griffith, G. J. Lush, A. J. Metheringham, and R. H. Thomas (London Univ.). Nucl. Phys., 60: 369-77 (Dec. 1964).

Proton–^{4}He scattering at 53 ± 4 Mev has been investigated using a high-pressure cloud chamber filled with helium. Differential cross sections for elastic scattering and for the $^4He(p,d)^3He$ reaction are presented. The total cross section for inelastic proton–^{4}He reactions, with no fast particles at laboratory angles less than 10°, at this energy is found to be 107.7 ± 4.4 mb. (auth)

44796 GAMMA DE-EXCITATION OF FISSION FRAGMENTS. I. PROMPT RADIATION. Sven A. E. Johansson (Univ. of California, Berkeley). Nucl. Phys., 60: 378-400 (Dec. 1964).

The gamma radiation emitted in fission of ^{252}Cf has been investigated in coincidence with the fission fragments. The mass ratio of the fragments was recorded, various properties of the radiation being studied as a function of the mass ratio. This paper deals with the prompt radiation, i.e., radiation with a half-life shorter than 1 nsec. The lifetime of the gamma-emitting states was measured by the time-of-flight technique. Using a collimator, the gamma radiation was detected after the fragments had traveled different distances. In this way, the decay curve was investigated and the half-life of the radiation was found to be about 10^{-11} sec. Using this information, it was possible to find a collimator setting that permitted a complete separation of the radiation from the two fragments. The properties of the radiation could then be studied as a function of mass. This arrangement was used to record gamma spectra for a number of different masses. It was found that there is a pronounced variation in spectrum shape. The spectra from fragments close to magic numbers are shifted to higher energies. With the same arrangement the yield of gamma rays was determined as a function of mass. The yield curve has a saw-tooth shape. The significance of the experimental results is discussed. The characteristic feature of the deexcitation process seems to be that it involves high spin states. It is estimated that the average value of the initial spin is about 10. The results of this work indicate that the radiation mainly consists of vibrational transitions. This fact is explained as a consequence of the conditions at scission. (auth)

44797 FINE STRUCTURE OF NUCLEAR γ RAYS IN MUONIC ATOMS. J. Heufner (Weizmann Inst. of Science, Rehovoth, Israel). Nucl. Phys., 60: 427-32(Dec. 1964).

Consequences of the electromagnetic interaction between an excited deformed nucleus and a muon, bound in the 1s Bohr orbit, are calculated. The interaction between the magnetic moment of the nucleus and that of the muon splits the nuclear levels into doublets. The spherically symmetric field of the 1s muon reduces the nuclear deformation, thus decreasing the moment of inertia and shifting the position of the rotational levels. Both these effects contribute to the fine structure of the emitted nuclear γ-rays. (auth)

44798 POLARIZATION IN NEUTRON-HELIUM ELASTIC SCATTERING AT 23 Mev. R. B. Perkins and C. Glashausser (Los Alamos Scientific Lab., N. Mex.). Nucl. Phys., 60: 433-40(Dec. 1964). (LADC-6452)

The asymmetry in the elastic scattering of 23 Mev polarized neutrons by helium was measured. A neutron-helium double scattering experiment was also performed with unpolarized 23-Mev neutrons to normalize the 23 Mev asymmetries to absolute polarizations in terms of the n-alpha analyzing power near 11 Mev. The $T(d,n)^4He$ source polarization at 30°, $E_d = 7.0$ Mev was found to be +0.489 ± 0.059. The measured n-alpha polarizations do not agree with the values predicted by the p-alpha phase shifts. (auth)

44799 POLARIZATION IN p-α ELASTIC SCATTERING. L. Drigo, C. Manduchi, G. C. Nardelli, M. T. Russo-Manduchi, and G. Zannoni (Università, Paduo and Istituto Nazionale di Fisica Nucleare, Padua). Nucl. Phys., 60: 441-50(Dec. 1964).

A systematic investigation has been carried out on the angular dependence of the polarization resulting from the elastic scattering of protons by α particles at laboratory angles ranging from 45 to 135° for proton energies between 4.04 and 4.78 Mev. The results are somewhat different from the predictions of phase shift analyses of elastic scattering angular distributions. It was found that this disagreement may be explained by making small changes in the S wave phase shift and in the splitting of the P and D phase shifts, without seriously affecting the fit to the angular distributions. (auth)

44800 THE NON-MESIC INTERACTIONS OF K⁻ MESONS IN HELIUM. A. K. Common and K. Higgins (London Univ.). Nucl. Phys., 60: 465-82(Dec. 1964).

The non-mesic capture processes of K^- mesons in helium have been investigated using a model developed for understanding the corresponding captures in deuterium. It is found that the calculated branching ratio of K^- non-mesic transitions in helium is of the observed order of magnitude as was found to be the case for capture in deuterium. With this model it is shown that the close nuclear correlations in the helium nucleus are better represented by an Irving wave function than by a Gaussian wave function. (auth)

44801 SCATTERING OF PIONS FROM NUCLEI. R. K. Umerjee (MATSCIENCE, Inst. of Mathematical Sciences, Madras). Nucl. Phys., 60: 497-502(Dec. 1964).

Elastic scattering of pions from complex nuclei is studied using the shell model and the impulse approximation. Numerical results are presented in the energy range 65 to 150 Mev for targets C and O. Comparison is made with experimental results. (auth)

44802 THE EXCITATION FUNCTION FOR THE REACTION $C^{12}(He^3,n_0)O^{14}$ BETWEEN THRESHOLD AND 11.45 Mev. D. R. Osgood, J. R. Patterson, and E. W. Titterton (Australian National Univ., Canberra). Nucl. Phys., 60: 503-8(Dec. 1964).

Observation of the 2.31-Mev γ ray yield from the production of ^{14}O in the $^{12}O(^3He,n)^{14}O$ reaction has enabled the excitation function (for transitions to the ground state) to be measured from threshold to 11.45 Mev using the activation technique. Significant structure is present over the whole energy range, with peaks being observed at 2.45, 2.75, 3.00, 4.65, 5.10, 5.85, 6.80, 7.70, 8.70, and 9.80 ± 0.05 Mev. Of these, the last seven may be interpreted as indicating new energy levels of ^{15}O at 15.79, 16.15, 16.75, 17.50, 18.23, 19.03, and 19.91 ± 0.05 Mev respectively. An absolute cross section scale for the reaction has been established. (auth)

44803 THE 15.1 Mev GAMMA-RAY EXCITATION FUNCTIONS OF THE REACTIONS $B^{10}(He^3,p\gamma_{15.1})C^{12}$, $B^{11}(d,n\gamma_{15.1})Cr^{12}$, AND $C^{13}(He^3,\alpha\gamma_{15.1})C^{12}$. Hsin-min Kuan, Peter R. Almond, G. U. Din, and T. W. Bonner (Rice Univ., Houston, Tex.). Nucl. Phys., 60: 509-17(Dec. 1964). (TID-20680)

The 15.1-Mev γ ray excitation functions of the reactions $^{10}B(^3He,p\gamma_{15.1})^{12}C$ (T = 1, 15.1 Mev state) from 1.8 to 5.5 Mev; $^{11}B(d,n\gamma_{15.1})^{12}C$ from 1.5 to 5.5 Mev; and $^{13}C(^3He,\alpha\gamma_{15.1})^{12}C$ from 2 to 5 Mev were measured. Resonances were observed in $^{10}B(^3He,p\gamma_{15.1})^{12}C$ at 2.85 ± 0.05 Mev (Γ_{lab} = 0.45 ± 0.05 Mev) and 5.2 ± 0.1 Mev (Γ_{lab} = 0.24 ± 0.08 Mev); in $^{11}B(d,n\gamma_{15.1})^{12}C$ at 2.18 ± 0.02 Mev (Γ_{lab} = 140 ± 20 kev), 3.08 ± 0.02 Mev (Γ_{lab} = 185 ± 20 kev), 3.71 ± 0.02 Mev (Γ_{lab} = 170 ± 25 kev), and 4.4 Mev (broad); and in $^{13}C(^3He,\alpha\gamma_{15.1})^{12}C$ at 2.6, 3.6, and 3.9 Mev. (auth)

44804 ELECTRICAL MONOPOLE TRANSITIONS IN NON-SPHERICAL NUCLEI. A. S. Davydov and V. S. Rostovskii (Moscow State Univ.). Nucl. Phys., 60: 529-43 (Dec. 1964).

Energy states are calculated for nonspherical even nuclei axially symmetric in the ground state. It is shown that if the interactions of the rotation with β and γ vibrations are fully taken into account, the wave functions and relative energies of excited states can be expressed through two parameters describing the amplitudes of zero β and γ vibrations of the nuclear surface. Relative probabilities for E0 and E2 transitions as functions of these parameters are calculated. The theory is compared with experiment. (auth)

44805 THE LEVELS OF A^{38}. W. R. Phillips (Univ. of Manchester, Eng.). Nucl. Phys., 60: 544-54(Dec. 1964).

Some low-lying levels in ^{38}Ar were investigated via the $^{34}S(\alpha,\gamma)^{38}Ar$ reaction and the beta decays of ^{38}Cl and ^{38}K. Nine 1^- resonances were found in the capture reaction for alpha particle bombarding energies between 3.0 and 3.6 Mev. From a study of the gamma radiation emitted from one of them, the third excited state of ^{38}Ar at 4.01 Mev was found to be 2^+ and the fourth excited state at 4.60 Mev to be 0^+. The 2^+ level decays chiefly via the second excited state, which is 3^-. These conclusions were verified by the indirect observations of a 0.5% branch to the 4.01-Mev level in the beta decay of ^{38}K. The results are discussed and compared with predictions of nuclear models. (auth)

44806 LEVEL PARAMETERS OF SHORT-LIVED NUCLEAR STATES. E. H. Berkowitz (Iowa State Univ., Iowa City). Nucl. Phys., 60: 555-60(Dec. 1964).

The measured widths of $^{8*}Be(2^+)$ and ^5He (ground) exhibit definite, systematic discrepancies. These discrepancies may indicate the operation of interaction in the final state between a spectator particle and a very short-lived ($\approx 10^{-22}$ sec) residual nucleus. Level shifts are expected to occur for such short-lived states decaying in the presence of a spectator particle. (auth)

44807 GAMMA RAY SPECTRA FROM FAST NEUTRON INTERACTIONS. J. L. Perkin (Atomic Weapons Research Establishment, Aldermaston, Berks, Eng.). Nucl. Phys., 60: 561-80(Dec. 1964).

Gamma spectra from ^6Li, C, N, O, Mg, Al, Si, S, Fe, Ni, Ba, W, and Pb were measured with a pair spectrometer at 90° from samples irradiated with neutrons of 3.5, 4.5, 5.5, 6.5, 7.5, and 8.5 Mev. The spectra were calibrated by reference to the neutron cross section for exciting the first excited states in ^{208}Pb and ^{12}C. The cross sections for the production of the resolved γ ray lines observed are in general agreement with previous work. The continuous spectra of γ rays observed from Fe, Ni, Ba, and W were compared with theoretical spectra derived from the statistical theory and the simplifying assumptions that all the γ transitions are of the dipole type and that the strength function for these transitions is constant in this energy region. The significant disagreement between experiment and theory in some cases is discussed. (auth)

44808 TRITON SPECTRUM FROM THE n + Li^7 REACTION. V. Valkovic (Institut "Rudjer Boskovic," Zagreb). Nucl. Phys., 60: 581-7(Dec. 1964).

The triton spectrum from the $n + {}^7Li \rightarrow t + \alpha + n$ reaction was measured at the neutron energy E_n = 14.4 Mev using a dE/dx, E counter telescope. The spectrum obtained shows an intensive peak corresponding to the neutron-α final state interaction in the ground state of ^5He. The continuous part of the spectrum was interpreted in the frame of a sequential decay model. It is shown that the spectrum cannot be explained purely on the assumption of final state interactions α-n in $^5He_{g.s.}$ and α-t in $^{7*}Li_{4.63Mev}$ (auth)

44809 STUDY OF THE REACTION $Li^7(p,\alpha)\alpha$ UP TO 12 Mev PROTON ENERGY. G. S. Mani (Univ. of Manchester, Eng.), R. Freeman, F. Picard, A. Sadeghi, and D. Redon. Nucl. Phys., 60: 588-92(Dec. 1964).

The ^7Li $(p,\alpha)\alpha$ reaction was studied up to 12-Mev proton energy. Four alpha-emitting states in ^8Be are observed. The results are discussed in terms of reaction mechanism and levels in ^8Be. (auth)

44810 ANOMALOUS L SUBSHELL RATIOS IN MIXED M1-E2 TRANSITIONS. T. Novakov and J. M. Hollander (Univ. of California, Berkeley). Nucl. Phys., 60: 593-608 (Dec. 1964). (UCRL-11400)

The L subshell ratios of a number of M1-E2 transitions were measured accurately with the Berkeley 50-cm iron free $\pi\sqrt{2}$ spectrometer. When the three L subshell conversion lines are resolved, the M1-E2 mixing ratio is overdetermined, because a unique value of δ^2 (i.e. E2/M1) is given by any one of the ratios L_I/L_{II}, L_I/L_{III} and L_{II}/L_{III}. (Algebraically only two of these ratios are independent.) Thus, if all three ratios are measured experimentally, the same value of δ^2 should in principle be obtained. In fact, this does not always appear to be the case. One of the most pronounced discrepancies is found in the case of the 103-kev transition in ^{153}Eu. The measured ratios are $L_I/L_{II} = 8.22 \pm 0.10$, $L_I/L_{III} = 20.65 \pm 0.28$ and $L_{II}/L_{III} = 2.51 \pm 0.05$. With use of carefully interpolated values from Sliv's tables, the E2 admixtures obtained are 2.02 ± 0.08, 1.66 ± 0.03, and 1.44 ± 0.06 percent, respectively. With Rose's values the E2 admixtures are 2.18 ± 0.08, 1.52 ± 0.03, and 1.15 ± 0.06 percent. Similar discrepancies were observed in the 114-kev transition in ^{175}Lu and 42- and 52-kev transitions in ^{249}Bk. Relatively good agreement with Sliv's values is found for the 69-kev transition in ^{153}Eu and for the 58-kev transition in ^{159}Tb. The agreement is generally better with Sliv's than with Rose's values. The two sets of theoretical L conversion coefficients differ sometimes by as much as 50%. (auth)

44811 HEAVY IONS EMITTED IN PHOTOGRAPHIC EMULSIONS BY 25 Gev PROTONS. R. Stein and H. Braun (Centre de Recherches Nucleaires, Strasbourg). Nucl. Phys., 60: 609-13(Dec. 1964). (In French)

Several hundred heavy ion tracks emitted from highly excited nuclei in photographic emulsion exposed to 25-Bev protons were investigated by means of a semiautomatic ionographic photometer. Energy spectra and angular distribution of the fragments were determined. It can be seen that anisotropy of the angular distribution and the mean energy of emitted fragments increases with the atomic number. (auth)

44812 NUCLEAR MOMENTS AND ISOTOPE AND ISOMER SHIFTS OF NEUTRON-DEFICIENT MERCURY ISOTOPES 195, 195^m, 194, 193, 193^m AND 192. W. J. Tomlinson, III, and H. H. Stroke (Massachusetts Inst. of Tech., Cambridge). Nucl. Phys., 60: 614-33(Dec. 1964).

Nuclear spins I, magnetic-dipole μ and electric-quadrupole Q moments and optical spectroscopic isotope and isomer shifts (I.S.) were obtained for the neutron-deficient mercury isotopes and isomers with mass numbers from 192 to 195. The isotopes were produced by p, yn reactions on ^{197}Au. Approximately 0.01 μg of Hg was transferred into the rf-excited electrodeless light sources. A well-blazed plane diffraction grating, 25 cm wide, was used in the multiple wavelength monochromator of 11 m focal length for these high-resolution optical hfs measurements. These lead to the results I = $\frac{1}{2}$ for ^{195}Hg, I = $\frac{13}{2}$ for ^{195m}Hg and ^{193m}Hg; $\mu = -1.05$, 0.53, -1.04 nm for ^{193m}Hg, ^{195}Hg, ^{195m}Hg, Q = 1.37, 1.41 b for ^{193m}Hg, ^{195m}Hg; with respect to ^{198}Hg, I.S. = 0.441 ± 0.020, 0.368 ± 0.006, 0.284 ± 0.007, 0.214 ± 0.008, 0.220 ± 0.005 cm^{-1} for ^{192}Hg, ^{193m}Hg, ^{194}Hg, ^{195}Hg and ^{195m}Hg. For ^{193}Hg the tentative results are I = $\frac{1}{2}$, $\mu = 0.56$ nm, and I.S. = 0.350 ± 0.027 cm^{-1}; the last result was obtained by Walter and Stroke in a magnetic-scanning experiment. The isotope- and isomer-shift results, which have led to a hypothesis of the cause of odd-even staggering in isotope shift, are discussed qualitatively in the light of the polarizability of nuclei by nucleons (coupling of core-excited states with odd particle). (auth)

44813 NUCLEAR POTENTIAL ENERGY AND THE SINGLE-PARTICLE DENSITY MATRIX. Kailash Kumar, K. J. Le Couteur, and M. K. Roy (Australian National Univ., Canberra). Nucl. Phys., 60: 634-40(Dec. 1964).

The approximations involved in obtaining a Fermi-Thomas type of theory for nuclei are related to the structure of the single-particle density matrix. Cases of both uniform and varying density are discussed. (auth)

44814 THE INTERACTIONS OF 24 Gev/c PROTONS WITH THE HEAVY NUCLEI OF NUCLEAR EMULSION EXPOSED IN A STRONG MAGNETIC FIELD. Krystyna Garbowska, Teresa Saniewska, Ewa Skrzypczak, and Przemyslaw Zielinski (Inst. of Nuclear Research, Warsaw and Univ. of Warsaw). Nucl. Phys., 60: 654-65(Dec. 1964).

In an emulsion stack irradiated by a beam of 24-Bev/c protons in the presence of a 180 kG magnetic field, 145 stars with $N_h > 8$ were analyzed. The stars correspond to a random sample of the interactions of primary protons with Ag and Br nuclei, characterized by high-energy transfers to the target nuclei. The statistical results concerning the momentum, transverse momentum, and angular distributions are given for positive and negative particles separately. The partition of the primary energy between the different types of secondaries is evaluated. The differences in statistical features of positive and negative secondaries are discussed. (auth)

44815 SYSTEMATICS OF l-FORBIDDEN M1 TRANSITIONS. I. M. Govil and C. S. Khurana (Aligarh Muslim Univ., India). Nucl. Phys., 60: 666-71(Dec. 1964).

The systematic behavior of the nuclear matrix element for l-forbidden M1 transitions as a function of neutron number was investigated. It was found that the value of the matrix element drops by a large factor at neutron magic numbers. Further it is seen that at these magic numbers the experimental value deviates more from single-particle estimates while it closely approaches the value calculated by Arima et al., on the basis of configurational mixing. (auth)

44816 THE EFFECT OF A RESONANCE ON A DIRECT PROCESS. A. Pfitzner and C. Riedel (Zentralinstitut für Kernforschung, Rossendorf, Ger.). Nucl. Phys., 60: 672-85(Dec. 1964). (In German)

A direct process is specified as a process proceeding by the direct participation of only one nucleon of the target, the so-called active nucleon. This process is described by the component of the total wave-function in the subspace of the one-particle excitations of the target. By the use of suitable projection operators the matrix element in the "single-resonance approximation" is constructed. Apart from the usual direct term a "resonance direct" term is obtained. In this extension of the direct reaction mechanism an appreciable energy dependence of the angular distribution is possible. This is demonstrated by a simplified test calculation for the reaction ^{12}C(p,p') in the energy range $3.42 \text{ Mev} \leq E_p \leq 3.62 \text{ Mev}$. (auth)

44817 NEUTRON-CAPTURE CROSS SECTION OF 35-h Rh-105. L. E. Glendenin (Argonne National Lab., Ill.) and R. A. Schmitt. Nucl. Sci. Eng., 20: 298-301(Nov. 1964).

The cross section for the reaction ^{105}Rh (n,γ) ^{106}Rh was measured using a TRIGA reactor in the pulsed mode of operation as a neutron source. The effective thermal-neutron (0 to 0.5 ev) cross section was found to be 13,300 ± 1,500 b, relative to a 36-b cross section for ^{59}Co. The cadmium ratio was observed to be ≥20 in a neutron flux for which a cadmium ratio of 7 was measured for cobalt. (auth)

44818 THERMAL-NEUTRON CAPTURE CROSS SECTION AND RESONANCE CAPTURE INTEGRAL OF Ce^{140} AND EFFECTIVE CAPTURE CROSS SECTION OF Ce^{141}. P. M. Lantz, C. R. Baldock, and L. E. Idom (Oak Ridge National Lab., Tenn.). Nucl. Sci. Eng., 20: 302-6(Nov. 1964).

The thermal-neutron capture cross section of ^{140}Ce and its resonance capture integral, measured by an activation method, were found to be 0.59 ± .06 and 0.48 ± .05 b, respectively. The effective capture cross section of ^{141}Ce in the Materials Testing Reactor was found to be 29 ± 3 b. This value was determined by mass analysis for the neutron-induced ^{141}Ce. (auth)

44819 THE STUDY OF SHORT-RANGE HYPERFRAGMENTS — THE DECAYS . A. W. Key, S. Lokanathan, and Y. Prakash (Oxford Univ.). Nuovo Cimento (10), 34: 274-86(Oct. 16, 1964).

A study of about 1500 short-range ($R_{H.F.} \leq 10$ μm) hyperfragments observed among K^- interactions at 3500, 1500, and 800 Mev/c was made. The binding energy (B_Λ) limits were obtained both from the nonmesonic and the mesonic decays of these hyperfragments. Mesonic decays of hyperfragments of mass number about 20 – 100 were observed and an upper limit of $B_\Lambda \approx (20 - 35)$ Mev was inferred. The problem of the Λ^0 binding energy in nuclear matter was also discussed. (auth)

44820 ISOBAR DECAY PRODUCTS IN HIGH-ENERGY NUCLEAR INTERACTIONS CAUSED BY COSMIC RAYS. M. Kazuno (Dublin Inst. for Advanced Studies). Nuovo Cimento (10), 34: 303-16(Oct. 16, 1964).

An attempt to distinguish the decay particles of isobars from multiple produced particles in the interactions of cosmic rays is made by the analysis of the angular distributions of the secondary produced particles, using the kinematical relations among the isobar decay particles. A method of separating the decay particles of isobars from the rest is introduced and applied in the analysis. The particles separated by the method appear in interactions of small inelasticity of high primary energy. The position and dispersion of the angular distribution of these particles on the log tg θ coordinate system were obtained and were consistent with those expected from the isobar decay process. It is found that the isobar decay process becomes appreciable in the energy region $>10^{12}$ ev. (auth)

44821 COULOMB AND COHERENT NUCLEAR PRODUCTION OF ρ's BY PIONS AND NUCLEI. P. C. Castoldi (Universita, Genoa). Nuovo Cimento (10), 34: 501-3 (Oct. 16, 1964).

An attempt is made to determine the $f_{\pi\rho\gamma}$ coupling constant through the coherent production of mesons (ρ) by mesons(π) in the Coulomb field of a nucleus and the product of the $f_{\pi\rho\omega}$, $f_{\omega NN}$ constants through the interfering process of the coherent nuclear production of mesons(ρ). It is found that, using the best estimate available of the coupling constants of interest, the Coulomb production is larger than the nuclear coherent production at an energy $\gtrsim$ 25 Bev within a cone $\leq 3 \times 10^{-2}$ degrees around the incident direction. Because of the smallness of this angle only the determination of the product $f_{\pi\rho\omega} \cdot f_{\omega NN}$ is effectively possible through the nuclear coherent production. The absorption effects in nuclear matter were neglected in the calculations. (C.E.S.)

44822 THE ANALYSIS OF (p,α) ANGULAR DISTRIBUTIONS BY THE USE OF POPULATION NUMBERS. Rolf Nordhagen (Universitet, Oslo). Phys. Norvegica, 1: 193-203(1963).

The alpha angular distributions from resonant levels in proton reactions are analyzed by introducing not only the resonant spin but also the population of the magnetic substates of the resonant level. The population is later analyzed in terms of the parameters describing the level formation. Tables are included giving the necessary coefficients for analyzing alpha-decay from levels of spin 1, 2, 3 and 4 to a level of spin 0. The populations of resonant states in the ^{27}Al (p,α) ^{24}Mg reaction previously studied by Andersen are obtained as an example. The formation analysis of these populations leads to essentially the same conclusions as the previous study, but more detailed information on the formation parameter limits is obtained. (auth)

44823 THE REACTION $^{24}Mg(d,p)^{25}Mg$ IN THE DEUTERON ENERGY RANGE 700-1500 kev. T. Grotdal and K. Nyboe (Bergen Univ., Norway). Phys. Norvegica, 1: 222-6(1964).

The excitation functions of the proton groups from the reaction $^{24}Mg(d,p)^{25}Mg$ corresponding to the five lowest levels in ^{25}Mg were studied, using deuterons at 700 to 1500 kev. The excitation functions show strong fluctuations. There is generally no symmetry about 90°, with energy correlation for the different proton groups in only a few cases. A qualitative description, based on a discussion of level densities in the compound system, indicates that the peaks in the excitation functions are not due to single levels, but rather to interference between several states, especially low-spin states with a fluctuating level density. (auth)

44824 THE YIELDS OF THE REACTIONS $^{23}Na(p,\gamma)^{24}Mg$, $^{23}Na(p,\alpha_{1,\gamma})^{20}Ne$, AND $^{23}Na(p,p_{1,\gamma})^{23}Na$ IN THE BOMBARDING ENERGY RANGE 860-1470 kev. R. Nordhagen and H. B. Steen (Universitet, Oslo). Phys. Norvegica, 1: 239-45(1964).

The relative and absolute gamma yields of the reactions $^{23}Na(p,\gamma)^{24}Mg$, $^{23}Na(p,\alpha_1,\gamma)^{20}Ne$ and $^{23}Na(p,p_1,\gamma)^{23}Na$ were measured in the proton energy range from 860 to 1470 kev. The main decay modes and relative intensities of the gamma spectra at 872, 986, 1019, 1161, 1172, 1202, 1252, 1281, 1317, 1392, 1415, and 1456 kev are given. Reduced particle widths and radiation widths are calculated for resonances which were previously assigned values of spin and parity. (auth)

44825 HYPERFINE RELAXATION OF OPTICALLY PUMPED Rb^{87} ATOMS IN BUFFER GASES. M. Arditi (International Telephone and Telegraph Corp., Nutley, N. J.) and T. R. Carver. Phys. Rev., 136: A643-9(Nov. 2, 1964).

The hyperfine relaxation of a population difference, produced by optical pumping, between the F = 1, $m_F = 0$ and F = 2, $m_F = 0$ energy levels of the ground state of ^{87}Rb, has been studied in cells containing neon, argon, helium, or krypton as a buffer gas. The relaxation times T_1 and T_2 have been measured as a function of the rubidium vapor pressure in the cell. The relaxation rate due to spin exchange in $^{87}Rb-^{87}Rb$ collisions has been found equal to 65 sec^{-1} at 44°C, and the diffusion coefficients of ^{87}Rb atoms in He, Ne, and Ar evaluated as 0.6, 0.31, and 0.22 $cm^2\ sec^{-1}$, respectively. The cross sections for $^{87}Rb-Ne$ and $^{87}Rb-Ar$ collisions are found to be 1.6×10^{-22} cm^2 and 9×10^{-22} cm^2. The extrapolated values of $1/T_2$ for zero vapor pressure of rubidium are 185, 237, and 318 sec^{-1} for Ne, He, or Ar respectively. Relaxations by the pumping light or by the magnetic field inhomogeneities are also discussed. (auth)

44826 QUADRUPOLE COUPLING AND KNIGHT SHIFT ANISOTROPY IN "HCP" LANTHANUM. D. R. Torgeson and R. G. Barnes (Ames Lab., Ames, Iowa). Phys. Rev., 136: A738-44(Nov. 2, 1964). (IS-889)

The nuclear magnetic resonance of ^{139}La has been observed in hcp polycrystalline lanthanum metal at 25.6 kOe and 300°K. The recorded pattern at 15.5 Mc displays a central line and one pair of satellite lines. The position and shape of the central line yield an isotropic Knight shift of (0.685 ± 0.020)% and an axial shift of (0.046 ± 0.020)%. The satellite spacing yields a lowest pure quadrupole frequency $\nu_Q = 101 \pm 4$ kc/sec or $e^2qQ/h = (1.41 \pm 0.06)$ Mc. A calculation of the lattice electric field gradient is made for the ABAC stacking sequences, yielding 0.540×10^{22} and 0.487×10^{22} cm^{-3} for the so-called A and B (or C) layer sites, respectively, by the method of plane-wise summation. Values of the nuclear electric quadrupole moment, $Q(^{139}La) = 0.21$ b, and the antishielding factor, $\gamma_\infty(La^{3+}) = -73.5$, are adopted and discussed. The sign of the conduction-electron electric field gradient is shown to be negative. (auth)

44827 NUCLEAR MAGNETIC RESONANCE STUDIES OF THE METALLIC TRANSITION IN DOPED SILICON. R. K. Sundfors and D. F. Holcomb (Cornell Univ., Ithaca, N. Y.). Phys. Rev., 136: A810-20(Nov. 2, 1964).

The Si : P and Si : B systems have been studied using the methods of pulse and cw nuclear magnetic resonance. The purpose of this study is to investigate the transition of an impurity system in a solid from an array of isolated paramagnetic atoms or clusters of atoms to a superlattice of impurity atoms having strong wave-function overlap and metallic character. Knight shifts, line shapes, and nuclear spin relaxation times were measured for ^{29}Si and ^{11}B in p-type silicon and ^{29}Si and ^{31}P in n-type silicon. Phosphorus concentrations vary from 10^{17} to 10^{20} impurities/cm^3 and the temperature range investigated extends from 1.4 to 300°K. Onset of metallic behavior in n-type silicon at 4×10^{18} phosphorus impurities/cm^3 is indicated by the $^{29}SiT_1$ becoming proportional to T^{-1} between 1.4 and 4.2°K and by the existence of a Knight shift for ^{29}Si. Above a phosphorus concentration of approximately 3×10^{19} cm^{-3}, ^{29}Si T_1's and Knight shifts obey the Korringa relation. Broadening of the ^{29}Si resonance line by 5 times the dipolar width and of the ^{31}P resonance line by 100 times the dipolar width at concentrations of 1.4×10^{20} cm^{-3} is shown to be caused by fluctuations of the local Knight shift about the average Knight shift value. Such fluctuations are explained by a model of a Poisson distribution for the local ^{31}P impurity density with a threshold local density of 3×10^{19} cm^{-3} for transition to metallic properties. This model agrees with the observed ^{31}P resonance line shape and explains the transition to metallic behavior in n-type silicon. In p-type silicon, ^{11}B and ^{29}Si Knight shifts are measured for boron concentrations greater than 1×10^{19} cm^{-3}. The ^{11}B T_1's and Knight shifts agree with the Korringa relation within a 15% experimental error. However, both the ^{11}B T_1 and Knight shift are independent of concentration for boron concentrations between 2×10^{19} and 8.5×10^{19} cm^{-3}. Such concentration independence may be explained by postulating a clustering of boron atoms at an average local density in a cluster greater than 8.5×10^{19} cm^{-3}. Wave function probability densities are calculated from Knight shifts with a free carrier density of states assumed valid. To facilitate comparison, wave-function densities are normalized per unit volume of the crystal and are 2600 cm^{-3} at ^{31}P and 100 cm^{-3} at ^{29}Si in n-type silicon and 80 cm^{-3} at ^{29}Si in p-type silicon. (auth)

44828 NUCLEAR INTERACTIONS AND ROTATIONAL MOMENT OF F_2. Irving Ozier, Lawrence M. Carpo, James W. Cederberg, and Norman F. Ramsey (Harvard Univ., Cambridge, Mass.). Phys. Rev. Letters, 13: 482-4 (Oct. 12, 1964).

The spin-rotation and spin-spin interaction constants of F_2 were determined, together with the rotational gyromagnetic ratio, from measurements by the molecular-beam, magnetic-resonance method. (D.C.W.)

44829 HYPERNUCLEAR SPECTROSCOPY IN THE UNITARY SYMMETRY MODEL. Yukio Tomozawa (Inst. for Advanced Study, Princeton, N. J.). Phys. Rev. Letters, 13: 512-14(Oct. 19, 1964).

The hyperfragments are classified in unitary multiplets under the assumption that nuclei are the members of the unitary multiplets which have the highest hypercharge. It is shown that irreducible representations of the group SU(3) to which nuclei belong can be determined uniquely by this assumption. Predictions for the properties of the hyperfragments are included. (D.C.W.)

44830 IMPULSE APPROXIMATION CALCULATIONS FOR THE $^{12}C(p,p\alpha)^8Be$ REACTION AT 150 Mev. M. W. Kermode (Univ. of Liverpool). Proc. Phys. Soc., (London), 84: 557-62(Oct. 1964).

The peak in the alpha particle angular distribution for the reaction $^{12}C(p,p\alpha)^8Be$ at 150 Mev was calculated in the impulse approximation without optical distortions. The result is sensitive to the set of nuclear wave functions used, being four times larger than the experimental value for one set and 140 times too large for the other. (auth)

44831 DYNAMIC POLARIZATION OF NUCLEAR TARGETS. A. Abragam and M. Borghini (Centre d'Etudes Nucleaires, Saclay, France). Prog. Low Temp. Phys., 4: 384-449(1964).

The dynamic polarization of protons, deuterons, and various nuclei for use as targets is discussed. Spin temperature theories of dynamic polarization are considered. A bibliography of 117 references is included. (C.E.S.)

44832 SEMICLASSICAL DESCRIPTION OF ROTATIONAL STATES IN DEFORMED NUCLEI — THREE DIMENSIONAL CASE. Yoshiyuki Shono (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 31: 990-1008 (June 1964).

A method describing the nuclear rotational motion of a nuclear system with a deformed equilibrium shape is investigated. As a simple example, the three-dimensional Q-Q interaction model is analyzed. It is found that the cranking model and this method are closely related. However, with this method angular velocities which characterize the classical rotations of a nuclear body are matrices. Thus a semiclassical picture is obtained for the nuclear rotations a deformed nuclear body rotates around a rotational axis which fluctuates quantum mechanically. (auth)

44833 ON THE "ANHARMONIC EFFECTS" ON THE COLLECTIVE OSCILLATIONS IN SPHERICAL EVEN NUCLEI. [PART] I. Toshio Marumori, Masatoshi Yamamura, and Akita Tokunaga (Kyoto Univ.). Progr. Theoret. Phys. (Kyoto), 31: 1009-25(June 1964).

A method by which the dynamics of the system of an even number of fermions can be transcribed into that of the ideal boson system is developed to permit analysis of the anharmonic effects on the collective oscillations in spherical even nuclei from the standpoint of the microscopic theory of the collective excitations. (D.C.W.)

44834 ON THE RELATION BETWEEN THE CRANKING MODEL AND PEIERLS-YOCCOZ METHOD. Yoshiyuki Shono (Hokkaido Univ., Sapporo). Progr. Theoret. Phys. (Kyoto), 31: 1163-5(June 1964).

The suitability of the cranking model and the Peierls–Yoccoz method for describing nuclear rotational motion was investigated, together with the relation between the two methods. (D.C.W.)

44835 RADIOCHEMICAL STUDIES OF FISSION INDUCED BY 14.7-Mev NEUTRONS. PART I. URANIUM. R. H. James, G. R. Martin, and D. J. Silvester (Univ. of Durham, Eng.). Radiochim. Acta, 3: 76-80(Oct. 1964).

Measurements were made of the yields of 19 nuclides from the fission of natural uranium (essentially ^{238}U) induced by neutrons of 14.7 ± 0.2 Mev. A peak-to-valley ratio of 9.4 was found with the yield at the maximum of the light peak measured as 6.5%. The maxima of the light and heavy peaks fall respectively at masses 99 and 136, the peak width at half height being 14 mass units. Measurements of the yields at masses 133 and 135 (made by gas counting the xenon members of the decay chains) provide evidence for fine structure in the yield/mass curve in this region. (auth)

44836 RADIOCHEMICAL STUDIES OF FISSION INDUCED BY 14.7-Mev NEUTRONS. PART II. THORIUM. S. J. Lyle, G. R. Martin, and J. E. Whitley (Univ. of Durham, Eng.). Radiochim. Acta, 3: 80-7(Oct. 1964).

Measurements were made of the yields of 14 nuclides from the fission of natural thorium (^{232}Th) induced by neutrons of 14.7 ± 0.2 Mev. A peak-to-valley yield ratio of 5.2 is found, with the yield at the maximum of the light peak measured as 6.50 ± 0.33%. The maxima of the light and heavy peaks fall respectively at masses 91 and 137, the peak width being 12.5 mass units. The probability of symmetric fission is discussed in terms of a simple liquid drop model, and it is shown that, over the range from ^{227}Ra to ^{240}Pu, this quantity shows a systematic dependence on an available energy term deduced from the model. (auth)

44837 HALF-LIFE OF CALCIUM 47. Carmen Gil-Montalbo (Tokyo Univ.). Radiochim. Acta, 3: 115-16(Oct. 1964).

A new determination of the half life of ^{47}Ca was made. The $^{48}Ca(\gamma,n)^{47}Ca$ reaction on ^{48}Ca enriched to 94% ^{48}Ca was used. The gamma spectrum was followed for 40 days. The half life was obtained from the total count rates in the range between 1.15 Mev and 1.52 Mev. In four experiments the values obtained were: $T_{\frac{1}{2}}$ = 4.533 ± 0.011, 4.547 ± 0.016, 4.528 ± 0.033, and 4.535 ± 0.015 days. The weighted mean is $T_{\frac{1}{2}}$ = 4.535 ± 0.004 days. (P.C.H.)

44838 THE STRUCTURE OF ATOMIC NUCLEI. A. Jones (Universite, Louvain, Belg.). Rev. Questions Sci., 457-79(Oct. 20, 1961). (In French)

A brief review is given of the static and dynamic properties of nuclei. The liquid drop model, Fermi gas model, optical model, shell model, and the unified model for nuclei are discussed with an indication of their ability to interpret nuclear properties. (J.S.R.)

44839 ON A VARIATIONAL METHOD AND THE RP-HRP APPROXIMATION. Shi-shu Wu (Kirin Univ., Manchuria). Sci. Sinica (Peking), 13: 1397-1409(Sept. 1964).

It is shown that the RP–HRP (random phase and higher random phase) approximation can be derived by a variational method. The reason why the secular matrix of the RP–HRP approximation is non-Hermitian is clarified, and a procedure which can lead it to be Hermitian is suggested. Furthermore, it is pointed out that the occupation factors can be determined by a second variational procedure and that new approximate methods can be devised if the variational method is combined with the method of Green's functions. (auth)

44840 POLARIZATION EFFECTS IN THE (α,d) REACTIONS. R. I. Dzhibuti and I. G. Ratishvili (Tbilisi State Univ., Georgian SSR). Soobshch. Akad. Nauk Gruz. SSR, 32: 319-26(1963). (In Russian)

A theoretical investigation of the angular distribution and polarization of the product particles in the (α,d) processes is carried out. The polarization is assumed to be due to the cross section asymmetry P = (dσ′ − dσ−)/dσ. General expressions are derived for the polarization of the particles with spin projections ±½ and 1; in the latter case the quadrupolarization must be also taken into consideration. The matrix elements for determining the components of the polarization spin tensor are evaluated by using the method of Butler. As a special case the reaction $^{10}B(\alpha,d)^{12}C$ is considered. (auth)

44841 THE ISENTROPE OF MATTER AT HIGH TEMPERATURES. G. V. Pinaeva. Soviet Astron.-AJ (English Transl.), 8: 17-18(July-Aug. 1964). Translated from Astron. Zh., 41: 25-7(Jan.-Feb. 1964).

The influence of the electron-positron pair production on the isentropic exponent at temperatures of the order of $m_e c^2$ = 500 kev is discussed. Results of numerical computations are given. From these it follows that due to pair production the isentropic exponent becomes smaller than ⅘ in any matter of low density at temperatures from 40 to 300 kev. (auth)

44842 APPLICATION OF THE PARTICLE-HOLE MODEL TO PHOTONUCLEAR REACTIONS IN CARBON AND OXYGEN. Egbert Boeker. Thesis, Amsterdam, Universiteit, 1963. 70p.

A number of characteristics of the giant resonance are calculated with the particle-hole model in order to test this model and its wave functions. It is supposed that the formation and decay of the highly excited states can be separated. The incident gamma radiation is decomposed into its different multipoles, and formulas for the absorption cross sections are derived. Gillet's wave functions and the calculated cross sections and gamma widths are tabulated for the 1^-, 1^+, and 2^+ levels of ^{12}C and the 1^- levels in ^{16}O. The R-matrix theory is used to calculate decay widths in nucleon channels. Angular distributions are calculated for ^{12}C. (C.E.S.)

44843 NUCLEAR RESONANCE IN MAGNETIC MATERIALS. A Course Given in 1961 by A. M. Portis at Osaka University. [Osaka, Osaka University, 1962]. 143p.

Lectures are presented on nuclear resonance in magnetic materials. Fundamentals of nuclear resonance absorption, nuclear studies in antiferromagnetic materials and ferromagnetic insulators, relaxation in ordered magnetic materials, resonance in paramagnetic insulators, resonance in ferromagnetic metals, relaxation in metals, and resonance in magnetic alloys are discussed. (C.E.S.)

44844 POLARIZATION IN n + C^{12} ELASTIC SCATTERING BETWEEN 1 AND 2 Mev. O. Aspelund (Aktiebolaget Atomenergi, Studsvik, Sweden). 5p. (CONF-502-20)

From International Congress of Nuclear Physics, Paris, July 1964.

The finite-geometry, left-right ratios (Basel convention) in elastic scattering of polarized neutrons by ^{12}C at 1 to 2 Mev were measured at scattering angles of 30, 41.8, 56, 85.2, 115.7, and 129°. The relative contribution of even-parity scattering was noted to decrease with decreasing neutron energy, while the absolute admixture of odd-parity scattering remained practically constant over the whole energy range, providing a significantly nonzero polarization in the backward hemisphere. The observations were compared with theoretical predictions. (D.C.W.)

44845 REACTION MECHANISM FOR DEUTERON INTERACTION WITH CARBON BELOW 5 Mev. J. M. Jeronymo, G. S. Mani, F. Picard, and A. Sadeghi (Centre d'Etudes Nucleaires, Saclay, France). 8p. (CONF-689-1)

From International Symposium on Direct Internations and Nuclear Reaction Mechanisms, Padua, Sept. 1962.

The excitation curves for deuteron elastic scattering by ^{12}C and for the $^{12}C(d,p)$ reaction to the four lowest levels of ^{13}C at deuteron energies of 0.9 to 5.0 Mev were measured at laboratory angles of 143.5 and 155°. Preliminary results are presented, and the large resonances observed are discussed in terms of reaction mechanisms. (D.C.W.)

Plasma Physics and Thermonuclear Processes

Refer also to abstracts 44408, 44500, and 44507.

44846 (AD-603950) THOMSON SCATTERING COMPUTATIONS FOR LABORATORY PLASMAS. Research Report No. 187. Edward T. Gerry and Richard M. Patrick (Avco Corp. Avco-Everett Research Lab., Everett, Mass.). Aug. 1964. Contract AF49(638)-1129. 10p.

Some calculations of the spectrum of Thomson scattering of a laser beam from typical laboratory plasmas are presented. The calculations are numerical results based on theoretical work by Salpeter. The results show that the character of the spectrum depends upon the ratio of the length in the plasma over which the scattered spectrum adds coherently to the Debye length, a. For small a, i.e., $a < 10^{-1}$, the spectrum is simply an electron Doppler-broadened spectrum. For medium a ($10^{-1} < a < 1$), the spectrum shows Doppler broadening due to both the ions and for large a ($1 \leq a$) there are peaks in the scattered spectrum displaced from the primary laser frequency by an amount approximately equal to the plasma frequency. These three regions are graphically displayed along with a universal numerical scattering calculation for a hydrogen plasma with equal ion and electron temperatures. Some typical cases are calculated for hydrogen plasmas showing the character of all three regions of a and the effect of changing scattering angle. (auth)

44847 (AFCRL-64-279) ELECTROMAGNETIC POTENTIALS AND FIELD EXPANSIONS FOR PLASMA RADIATION IN WAVEGUIDES. Scientific Report No. 5. Robert E. Collin (Case Inst. of Tech., Cleveland). Mar. 1964. Contract AF19(628)-1699. 40p. (AD-601394)

In order to calculate the radiation from plasma placed in waveguides it is necessary to know the field produced by arbitrarily moving charged particles in a waveguide. Modal expansions for the vector and scalar potentials due to arbitrarily moving charged particles in a waveguide are derived and provide the generalization of the Lienard-Wiechart potentials to a waveguide environment. In addition, for a plasma-filled waveguide, a modal expansion of the electric field directly in terms of mode coupling with the charge motion is given. Expressions for the spectral distribution of the radiation are also obtained, both in general and for cyclotron radiation. Some specific results for the H_{10} mode excited in a rectangular guide by cyclotron motion are also presented. (auth)

44848 (AFCRL-64-280) A STUDY OF EXTREMELY LOW-FREQUENCY WAVE MOTIONS. Final Report. A. Cantor and J. Farber (Sylvania Electronic Systems. Applied Research Lab., Waltham, Mass.). Feb. 26, 1964. Contract AF19(628)-340. 110p. (AD-601608)

The report continues and extends the work of Scientific Report No. 1 (AD-408 099), dated 30 April 1963, in which the behavior of a model ionospheric plasma is studied in the extra-low-frequency limit, and from several points of view. The normal and anomalous Cherenkov-like effects there derived are considered further, and improvements in the theoretical formulation of plasma problems are considered. (auth)

44849 (AFCRL-64-528) THE THERMAL AND ELECTRICAL CONDUCTIVITY OF COOLING STELLAR PLASMA EMITTING NEUTRINOS. Scientific Report No. 4. Ik-Ju Kang and Jack S. Goldstein (Brandeis Univ., Waltham, Mass.). June 10, 1964. Contract AF19(604)-7283. 65p.

The contribution of the URCA process to the thermal and electrical conductivities is calculated for the cooling stellar plasma, whose mass density, ρ, is of the order of $\rho \geq 10^6$ g/cc, and the temperature of which is of the order of 10^9 °K, based on the assumption that the number of degenerate electrons is conserved in first order. The contribution is found to enhance the transport coefficients, but is negligibly small for the range of mass density 10^6 to 10^{15} g/cc. (auth)

44850 (CLM-R37) A SINGLE-LOOP CONDUCTOR FOR PRODUCING A MAGNETIC WELL. F. M. Larkin (United Kingdom Atomic Energy Authority. Research Group. Culham Lab., Culham, Abingdon, Berks, England). June 1964. 16p.

The report describes a single-loop conductor, shaped like the seam on a tennis ball, which generates the simplest type of magnetic well. Some contours of constant field strength are presented, for a number of variations on the standard case, which illustrate the possible range of mirror ratios. Also a preliminary study indicates that an efficiency of at least 60% may be achieved in the Lorentz trapping of injected neutral atoms. (auth)

44851 (EUR-535.i) STABILITA' DI UN PLASMA NON UNIFORME SENZA COLLISIONI. (Stability of a Collisionless, Non-Uniform Plasma). B. Bertotti (Italy. Comitato Nazionale per l'Energia Nucleare. Laboratori Nazionali, Frascati). 1964. 6p. (CONF-468-2)

From Conference on Some Aspects of the Physics of Plasma, Milan, May 1963.

The transition between two plasma regions where the magnetic field has a different intensity occurs through a current sheath whose thickness is not smaller than the electrons' Larmor radius r. The stability of this system against electrostatic perturbations whose wavelength, proportional to the Debye length, is much smaller than r is discussed. (auth)

44852 (MATT-273) A TECHNIQUE FOR MEASURING PHASE MODULATION OR RAPID PHASE CHANGES OF A MICROWAVE SIGNAL. W. P. Ernst (Princeton Univ., N. J. Plasma Physics Lab.). June 1964. Contract AT(30-1)-1238. 35p.

The system takes advantage of the fact that a phase-modulated carrier signal will produce equivalent frequency modulation, where the change of frequency is proportional to the time rate of change of the phase variation. A microwave carrier frequency fc is shifted in a single-side-band generator to a frequency, fc + fm. The upper side band is transmitted through the phase modulating medium and then mixed with the original carrier frequency. The difference frequency fm contains the phase modulation information and, after preamplification, the signal is put through a wide-band limiter-discriminator of center frequency fm. The discriminator output voltage will be directly proportional to the rate of phase change. To compensate for the time rate of change

dependency, the discriminator output is followed by an integrating network (Eo ~ 1/f), which will produce an output voltage proportional to the phase change only. Calibration is accomplished by imposing a known amount of phase modulation on the side band modulating signal fm and observing the system output signal. This measuring scheme was built in the 70-Bc/s band and is capable of following a wide range of phase changes over microsecond periods. (auth)

44853 (ML-1214) EXPERIMENTAL AND THEORETICAL RESULTS ON ELECTRON BEAM/PLASMA INTERACTION. F. W. Crawford (Stanford Univ., Calif. Microwave Lab.). Aug. 1964. Contract AT(04-3)-326. 38p.

Beam-plasma interaction, wanted or otherwise, is an important feature of many branches of plasma physics. A complete theoretical description of interaction in the general practical case of a nonuniform, warm, bounded system, subject to collisions and immersed in a magnetic field is prohibitively complex, and progress in understanding the basic mechanism is best made by considering appropriately simplified models. Recent progress at Stanford on the theoretical and experimental characteristics of beam-plasma interactions in the absence of a static magnetic field are reviewed. Computed results in bounded and unbounded uniform systems are quoted, and experimental data on r-f gain and phase-shift obtained in low-pressure mercury-vapor discharges by two different techniques are presented. (auth)

44854 (ML-1215) A REVIEW OF CYCLOTRON HARMONIC PHENOMENA IN PLASMAS. F. W. Crawford (Stanford Univ., Calif. Microwave Lab.). Aug. 1964. Contract NSF GP-936. 53p.

In recent years, cyclotron harmonic phenomena have been encountered in many branches of plasma physics. For example, anomalously high noise radiation near to the electron and ion cyclotron harmonic frequencies ($n\omega_{ce}$,$n\omega_{ci}$) has been observed from plasmas used in thermonuclear fusion studies. Transmission resonances near ($n\omega_{ce}$) have been detected in the laboratory in perpendicular propagation studies, while satellite explorations have established the existence of ionospheric resonance effects in the vicinity of these frequencies. The objects of the report are to interpret and to explain the substantial volume of experimental data accumulated on cyclotron harmonic phenomena. This is done in terms of cyclotron harmonic waves, the propagation of which has been predicted for warm plasmas in a magnetic field. The review gives a brief outline of the theory involved, and concentrates on the basic physical mechanisms of the effects observed experimentally. These phenomena are of considerable practical importance in the understanding of processes occurring in fusion study devices, other laboratory discharges, and the ionosphere, and there are several potential applications to plasma diagnostics. The paper concludes with a brief discussion of these. 93 references. (auth)

44855 (ML-1216) EXCITATION OF ION CYCLOTRON HARMONIC WAVES IN PLASMA. F. W. Crawford (Stanford Univ., Calif. Microwave Lab.). Aug. 1964. Contract AT(04-3)-326. 35p. (CONF-564-2)

From Colloquim on Interaction Between Electromagnetic Waves and Plasma, Saclay, France, Sept. 1964.

In recent years, electron cyclotron harmonic phenomena have been encountered in plasma physics experiments as widely separated as noise radiation measurement on fusion study machines, perpendicular transmission in low-pressure, low-temperature discharges, and radar reflection measurements made by an ionospheric sounder satellite. In each case the data can be satisfactorily interpreted in terms of electron cyclotron harmonic waves, the existence and properties of which have been predicted theoretically and discussed by previous workers. Similar propagation may be predicted in passbands centered on the ion cyclotron harmonic frequencies, and may be related to ion cyclotron harmonic emission observed in fusion studies. A general description is given of the underlying physical mechanism of cyclotron harmonic resonance in a warm plasma, and the analysis is specialized to ion effects. The particular case of excitation of ion cyclotron harmonic waves by interaction of a charged particle stream and the plasma is discussed, together with the relevance of the phenomena to fusion plasma, and ionospheric research. (auth)

44856 (ORNL-P-456) STUDIES IN THE HALO OF THE DEUTERIUM ARC AND A PIG-TYPE DISCHARGE. N. H. Lazar, C. W. Blue, R. A. Gibbons, and O. D. Matlock (Oak Ridge National Lab., Tenn.). Sept. 3, 1964. Contract W-7405-eng-26. 23p. (CONF-709-1)

From International Symposium on Diffusion of Plasma Across a Magnetic Field, Bavaria, Ger., June-July 1964.

The radial distribution of ion density was measured in the halo of the arc column in the Gas Arc Facility as a function of magnetic field. The source of the high-pressure gas observed in the arc operation was found to be due to cross-field transport of some of the arc plasma and subsequent ion recombination on the end walls. Similar experiments were carried out for a PIG-type arc discharge because of interest in the plasma source. (R.E.U.)

44857 (PIBMRI-1165-63) INVESTIGATION OF AN RF PROBING TECHNIQUE FOR THE MEASUREMENT OF LOW PLASMA ELECTRON DENSITIES. Nicolas Worontzoff (Brooklyn. Polytechnic Inst.). Apr. 1964. Contract AF30(602)-2149. 59p. (RADC-TDR-64-110; AD-601533)

The report describes experiments relating to electromagnetic probing of a low-density plasma at frequencies in the range 100 to 300 Mc. In particular the limitations on a parallel-plate capacitor probe and a coaxial discharge tube are described. (auth)

44858 (RADC-TDR-64-117) MICROWAVE AND ELECTRON BEAM INTERACTIONS WITH A FINITE PLASMA. H. L. Stover (Stanford Univ. Microwave Lab.). Apr. 1964. Contract AF30(602)-2575. 251p. (AD-601363)

The purpose of the study was to investigate in detail, both theoretically and experimentally, the interaction between an electron beam and a finite plasma system. In the formal theoretical analysis, the plasma and beam are treated as frequency-dependent dielectrics. Exact solutions to the Maxwell equations are obtained and the exact dispersion relation is obtained for a beam and plasma filling a waveguide. A propagation and field theory is developed, both analytically and numerically, for the slow waves on a plasma column (without beam), which has a radial variation in electron density and is in a d-c magnetic field. It is predicted that it should be difficult to couple to the n = 0 (i.e., no angular dependence) backward-wave modes, and this prediction is borne out experimentally. A gain theory is developed, both analytically and numerically, for a zero-temperature finite beam-plasma system in a finite d-c magnetic field. The gain is predicted to be finite at all frequencies even though the temperature effects are neglected, the finiteness of the system being of far greater importance than the temperature effects. The attenuation of the slow waves on a plasma column is investigated both theoretically and experimentally. (auth)

44859 (SU-SEL-64-036) EXPERIMENTAL ANALYSIS OF A TOROIDAL DISCHARGE. Technical Report No. 0253-5. D. R. Pigache, J. Hosea, and G. F. Reiter (Stanford Univ., Calif. Electron Devices Lab.). May 1964. Contract AT(04-3)-326. 36p.

A pulsed homogeneous toroidal reflex discharge was investigated. The mechanism of operation is explained and was confirmed experimentally. Langmuir-probe measurements were made of electron temperature and density throughout the pulse and afterglow, and the density measurements were confirmed by interferometer measurements. Drift losses are calculated from the temperature measurements, and agree well with those measured directly from the density variation. The losses are proportional to 1/B, as expected. A second pulse is injected in the afterglow, which causes a decay of densities. This decay is shown to be due to increased curvature losses arising from the heating of the plasma. The results of the experiments provide the diagnostic tools and basic data with which future toroidal confinement schemes, aimed at eliminating drift losses, can be evaluated and compared. (auth)

44860 (TID-21149) RESEARCH ON INSTABILITIES IN HIGHLY IONIZED LOW-PRESSURE METAL-VAPOR PLASMAS. Progress Report. E. M. Williams (Carnegie Inst. of Tech., Pittsburgh). June 22, 1964. Contract AT(30-1)-3100. 182p. (EAC-2)

An initial experimental investigation was carried through a first stage of completion. This investigation deals with the phenomena accompanying the instability of the positive column of a low-density highly ionized metal-vapor plasma, in a configuration with a sharp discontinuity in column diameter. In this configuration, a plasma sac is formed, essentially as an extension of the smaller diameter (constricted) section of the plasma column into the large diameter (unconstricted section). For convenience, the resulting phenomenon is referred to as a PIACC (plasma instability at a column constriction) phenomenon. Experimental studies were conducted with a mercury-vapor column and a time-sampled swept-probe instrumentation technique. Although the details of the experiments require improvements, the findings to date are promising. The onset of the instability is preceded by an abnormal increase in electron temperature within the plasma sac, with consistent values in the range of 100,000 to 300,000°K recorded. The electron temperature in the plasma outside the sac remains practically constant at much lower values; the voltage drop across the double sheath enclosing the plasma sac increases in proportion to the temperature difference for the electrons within and without the sheath. However, the drift energy acquired by the electrons in crossing the double sheath is highly randomized, for reasons which are as yet not easily explainable, especially in view of the rather long mean-free-path to be expected in a mercury-vapor plasma at the low pressures involved. The experimental apparatus and experimental findings, some approximate models for the plasma-sac configuration, the details of the swept-probe instrumentation, and an orbital model for the steady-state plasma sac are described. (auth)

44861 (UCRL-11407) THE EFFECT OF COLLISIONS ON ION CYCLOTRON WAVES (thesis). David Larry Sachs (California. Univ., Berkeley. Lawrence Radiation Lab.). May 1, 1964. Contract W-7405-eng-48. 131p.

The behavior of a transverse electromagnetic wave propagating in the direction of a uniform magnetic field in a fully ionized plasma is examined. Linearized kinetic equations with collision terms of the Krook-Bhatnager-Gross type extended by Liboff to include interspecies collisional effects are used in the solution of a spatial boundary-value problem. The region of ion cyclotron resonance is closely investigated, and the transition of the dispersion relation from the low-temperature, collision-dominated regime to the high-temperature regime is observed. It is found that moments of the equations are adequate in the collision-dominated regime, but the kinetic equation for the ions must be used at higher temperatures. At these higher temperatures a complete solution of the problem requires numerical work near the source plane. Far from the source, explicit solutions for the fields can be written. (auth)

44862 (UCRL-Trans-1077(L)) RADIATION ACCELERATION OF PLASMA. V. I. Veksler, I. R. Gekker, E. Ya. Gol'ts, et al. (Akademiya Nauk S.S.S.R. Institut Fiziki im. P. N. Lebedeva and Akademiya Nauk S.S.S.R. Radiotechnicheskii Institut). Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore), from report NTD-6317R, 1963, 17p.

The operation of waveguides for electromagnetic-field acceleration of a plasma was studied experimentally and theoretically. The radiation method is shown to be feasible. (R.E.U.)

44863 (UCRL-Trans-1084(L)) ON CYCLOTRON RADIATION OF "SOUND" WAVES BY IONS IN NON-ISOTHERMAL PLASMA. V. I. Pakhomov. Translated by Sergey Shewchuck (Univ. of California Lawrence Radiation Lab., Livermore), from Ukr. Fiz. Zh., 8: 595-7(1963). 6p.

It is shown that for Alfven wave velocity much greater than the velocity of sound in plasma, the intensity of the cyclotron radiation of the "sound" wave is greater than that of radiation of the ordinary and extraordinary waves by an order of magnitude of $(V_A/V_S)^{2s+1}$ for the s^{th} harmonic. (R.E.U.)

44864 CONSIDERATIONS IN DYNAMICS STUDIES AND ANALOG SIMULATION OF FUSION REACTORS. Giovanni Marchesini (Università, Padua). Automazione Strumentazione, 12: 285-91(July 1964). (In Italian)

A study was made to show through which simplifications, and to what extent, it would be possible to describe the fusion reactor in terms analogous to those most frequently adopted for fission reactors. The problems in the determination of a mathematical model with consideration of the reactor dynamics are reviewed for the fission reactor, and presented for the fusion reactor. The analysis showed that the dynamics did not differ substantially from each other with respect to analog simulation and study of control systems. (J.S.R.)

44865 ALFVEN WAVES IN INHOMOGENEOUS PLASMAS. A. Skorupski (Inst. for Nuclear Research, Polish Academy of Sciences, Warsaw). Bull. Acad. Polon. Sci., Ser. Sci., Math., Astron. Phys., 12: 329-34(1964).

The results of Gajewski and Winterberg concerning Alfvén waves in inhomogeneous magnetic fields are generalized for inhomogeneous plasmas and magnetic fields that are not external. Particularly the case of a plane and rotational symmetry of the magnetic field in equilibrium is considered and the corresponding differential equations for the vector potential are derived. A differential equation describing the Alfvén waves was reduced to a form convenient for approximations. (auth)

44866 RADIATION FROM SOURCES IMMERSED IN COMPRESSIBLE PLASMA MEDIA. James R. Wait (National Bureau of Standards, Boulder, Colo.). Can. J. Phys., 42: 1760-79(Sept. 1964).

Boundary value problems involving dielectric and compressible plasma media are considered. The geometrical configurations are idealized to the extent that Maxwell's equations, when combined with continuum theory of fluid dynamics, are separable. The specific problems considered are motivated by a need to understand radiation of sources immersed in compressible isotropic ionized media. Various results for cold plasma configurations are recovered when the (electron) acoustic velocity is allowed to approach zero. Phenomena related to the resonance in the dielectric cavity which contains the sources are briefly considered. In particular, it is shown that the resonant conditions are modified appreciably by the finite compressibility of the surrounding plasma. (auth)

44867 ONE POSSIBILITY OF H-F SEALING OF MAGNETIC TRAP WITH CUSPED FIELD. V. A. Petržílka and J. Teichmann (Inst. of Plasma Physics, Prague). Czech. J. Phys., 14: 485-500(1964).

The behavior of plasma is analyzed in the region of cusped fields where the magnetostatic field near the plane of symmetry can be regarded as homogeneous. The case is studied in which the motion of the plasma along the lines of force of the magnetostatic field is limited by the effect of the h-f field of a simple mode. The dynamics of electron and ion gases are studied in the one-particle and linear approximation, and it is shown that in the neighborhood of the plasma-vacuum boundary the plasma particles perform oscillations with limited amplitude only for some values of the parameters of the plasma and external fields. When the gradients of the h-f field are large, these regions of stationary oscillations of plasma are relatively narrow and the interaction between the h-f field and the plasma is apparent as the non-stationary acceleration of plasma. Resonance phenomena are dealt with. The stability of a plasma-vacuum boundary for the case of stationary equilibrium between the plasma and the h-f field is investigated on the basis of the MHD approximation. It is seen for the model of a plane boundary that in the case in question, when the lines of force of the magnetostatic field are perpendicular to the plasma boundary, the stability conditions in the first approximation agree with the case in which the magnetostatic field is parallel to the boundary. In order to obtain a more exact description of the interaction, the dispersion relation is analyzed that is obtained by linearization of the MHD equations for the plasma boundary in the form of an infinitely long cylinder. (auth)

44868 HYDROMAGNETIC INSTABILITY OF CONTRA-STREAMING PLASMAS. A. Hruška (Inst. of Geophysics, Prague). Czech. J. Phys., 14: 586-93(1964).

The stability of the system consisting of two contra-streaming plasmas is discussed in the limit of low-frequency perturbations. The existence of an external magnetic field parallel to the velocity of the contra-streaming is admitted. It is shown that the system is unstable whenever the density of kinetic energy belonging to the relative motion of the two plasmas exceeds the magnetic energy density. (aith)

44869 RESONANCE CONDITIONS OF ACCELERATION OF CLUSTERS OF PLASMA BETWEEN PARALLEL CONDUCTORS. J. Kracik (Czech. Tech. Univ., Prague). Czech. J. Phys., 14: 683-9(1964).

Data for the maximum attainable velocity of a cluster were found from magnetohydrodynamic equations and from relations for the electric circuit of conductors and sources for the acceleration of clusters of plasma between parallel conductors with an external magnetic field. These equations give the relation between the parameters of the external circuit, the mass of the accelerated cluster and the magnetic induction of the external magnetic field, and simultaneously the length of the conductors which is necessary for attaining maximum velocity. The conditions obtained were called resonance conditions. (auth)

44870 SPECTRAL ANALYSIS OF STANDING LAYERS IN THE PLASMA OF A POSITIVE COLUMN IN LOW-PRESSURE DISCHARGES IN HYDROGEN. O. Stirand and S. Veprek (Inst. of Physics, Prague). Czech. J. Phys., 14: 690-7(1964). (In German)

The optical spectral analysis of a standing periodic structure in the plasma of a positive column was investigated. Both the spectral composition of the radiation of the discharge along the axis of the discharge over one period and the radiation absorption along the striation were measured. In this way some information was obtained on the gaseous components which play a role in the emission of light with respect to their exciting, ionization, or dissociation energies as well as on the distribution of the metastable states of atomic hydrogen. The results showed that molecular hydrogen is mainly dissociated on atomic hydrogen at the front of the striation. The hypothesis was proposed that negative ions of the intrinsic gas (hydrogen) or ions of an admixture of other gases have an important influence on the process of recombination which takes place in the dark of the striation. (auth)

44871 ON THE KINEMATICS OF MAGNETIC FIELD LINES IN PLASMA. Peter Mauersberger (Institut fur Physikalische Hydrographie, Deutsche Akademie der Wissenschaften, Berlin). Geofis. Pure Appl., 57: 143-8 (1964). (In German)

The kinematics of magnetic field lines in a plasma can be studied by means of the mathematical methods used in the kinematics of vorticity. Starting with Faraday's law of induction for moving circuits the following results can be derived: a necessary and sufficient condition that the magnetic field lines remain material lines; a formula describing the convection and diffusion of the magnetic field lines in a plasma, which is analogous to the basic vorticity formula of C. Truesdell; general theorems containing an arbitrary tensor field of any order, which are analogous to general vorticity theorems of H. Ertel, especially a commutation formula corresponding to the Euler-Ertel commutation formula for circulation preserving motions. Given an isentropic ideal plasma it follows that $d/dt\ (1/\eta \vec{B} \cdot \text{grad } s) = 0$ (η denoting the density, $\vec{B}$ the magnetic induction, s the specific entropy, and d/dt the material time derivative). (auth)

44872 STRUCTURE OF THE DISTURBED ZONE IN THE NEIGHBORHOOD OF A LARGE CHARGED BODY IN PLASMA. A. V. Gurevich (Lebedev Inst. of Physics, Moscow). Geomagnetism Aeronomy (USSR) (English Transl.), 3: 822-32(1963).

A study was made of the disturbances caused in plasma by a charged spherical body whose dimension is much greater than the Debye radius. The electric field and the distribution of electrons and ions in the neighborhood of the body when there is an arbitrary field potential on its surface were determined. The intensity of the electric field was determined. The total flux of ions and electrons at the surface of the body was computed and a probe characteristic derived. (auth)

44873 MAGNETIC FIELD DISTURBANCES AROUND A BODY MOVING IN PLASMA. L. P. Pitaevskii (Inst. of Physical Problems, Academy of Sciences, USSR). Geomagnetism Aeronomy (USSR) (English Transl.), 3: 833-42 (1963).

The kinetic theory was used as a basis for derivation of expressions for the Fourier components of magnetic field disturbances around a body moving in rarefied magnetized plasma. Formulas also were derived for the Fourier components of disturbances of concentrations of charged particles with an allowance for the influence of disturbances of the magnetic field on the motion of electrons and ions. (auth)

44874 ON ELECTROMAGNETIC WAVE SCATTERING IN NON-EQUILIBRIUM PLASMA. N. V. Sholokhov (Lebedev Inst. of Physics, Moscow). Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 7: 452-9(1964). (In Russian)

The influence of plasma transverse waves upon the scattering of electromagnetic waves by a plasma—beam system is investigated. (auth)

44875 ON THE NON-LINEAR PLASMA WAVE EXCITATIONS. A. G. Litvak (Gor'kii Univ., USSR). Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 7: 562-3(1964). (In Russian)

In a magnetoactive plasma, strong plasma waves can generate pairs of electromagnetic waves whose frequencies ω_1 and ω_2 and wave vectors k_1 and k_2 satisfy $\Omega = \omega_1 + \omega_2$ and $k = k_1 + k_2$, where Ω and k are the frequency and wave vector of the plasma wave; this effect is possible since electromagnetic waves with frequencies ω_1 and $\omega_2 < \Omega$ do not diffuse in an isotropic plasma. For waves satisfying $\Omega = \omega_1 - \omega_2$ and $k = k_1 - k_2$ there is no instability. It is shown that for diffusion in an isotropic plasma, the plasma wave satisfying the latter relations excites pairs of strong plane electromagnetic waves. (M.J.T.)

44876 SELF-FOCUSING OF ELECTROMAGNETIC WAVES IN NON-LINEAR MEDIA. V. I. Talanov. Izv. Vysshikh Uchebn. Zavedenii, Radiofiz., 7: 564-5(1964). (In Russian)

A strong high-frequency field acting on a plasma causes a redistribution of the electron and ion densities, depending on the field amplitude; this effect can produce self-focusing of the electromagnetic waves. This possibility is illustrated by the example of an isothermal equilibrium hydrogen plasma in a monochromatic field of given frequency. The dependence of the dielectric permeability of the plasma on the field gradient is considered for two-dimensional TE and TM traveling waves, not taking into consideration collisions or spatial dispersion. (M.J.T.)

44877 THE TRAVELLING-WAVE PLASMA CONVERTER. H. K. Messerle (Univ. of Sydney). J. Fluid Mech., 19: 577-90(Aug. 1964).

The travelling-wave plasma converter is analyzed allowing for the compressible nature of the fluid. The study is restricted to conditions for which the magnetic Reynolds number is small. Steady and time-varying flow conditions are investigated using small perturbation theory. Relations for optimum conversion effectiveness are established and the effects of variable electrical conductivity are investigated. Conditions for electromechanical resonance are derived and it is shown that the conversion process introduces a damping effect. (auth)

44878 THE HOSE INSTABILITY DISPERSION RELATION. Steven Weinberg (Univ. of California, Berkeley). J. Math. Phys. (N. Y.), 5: 1371-86(Oct. 1964).

The dispersion relation is obtained for the "hose" instability in a modulated beam of charged particles traveling through a finite ohmic plasma channel. For a relativistic beam, the low-frequency mode obeys a dispersion relation of the same form as for the unmodulated beam, but it involves a constant which must be obtained by machine computation. For a large enough modulation frequency, the dispersion relation is identical to that for an unmodulated beam. (auth)

44879 EQUATIONS OF A HOT INHOMOGENEOUS PLASMA MODEL. I. RESONANCE FREQUENCIES OF A CYLINDRICAL PLASMA COLUMN. P. E. Vandenplas (Ecole Royale Militaire, Brussels) and R. W. Gould. J. Nuclear Energy, Pt. C, 6: 449-58(Sept.-Oct. 1964).

A system of eight equations with eight unknowns, describing a coherent model of a hot and non-homogeneous cylindrical plasma is established. The model is characterized by a non-constant electronic equilibrium density, the density gradient being balanced by an electrostatic field. The system of equations reduces to a system of six first-order, ordinary linear differential equations with variable coefficients. The tensorial generalization of the initial system is derived. The resonance frequencies of a cylindrical plasma column corresponding to the proposed model are investigated. These frequencies are determined by the method of the scattering cross section of the column relative to a plane homogeneous electromagnetic wave with electric field strength perpendicular to the cylinder axis. (auth)

44880 EQUATIONS OF A HOT INHOMOGENEOUS PLASMA MODEL. II. PERTURBED SCALAR PRESSURE APPROXIMATION. P. E. Vandenplas and A. M. Messiaen (Ecole Royale Militaire, Brussels). J. Nuclear Energy, Pt. C, 6: 459-68(Sept.-Oct.1964).

The scattering behavior of a hot nonuniform plasma cylinder is studied in the perturbed scalar pressure approximation. A theoretical representation of the reflected field as a function of the plasma electron density is obtained, which shows a striking resemblance to the observational data. The quantitative agreement with experiments is fair and is shown to depend on the bulk density distribution adopted. (auth)

44881 ON THE KINETIC EQUATION FOR A HOMOGENEOUS PLASMA UNDER NEAR-EQUILIBRIUM CONDITIONS. J. J. Sanderson (Univ. of Maryland, College Park). J. Nuclear Energy, Pt. C, 6: 469-76(Sept.-Oct. 1964).

The velocity distribution function for a homogeneous, fully ionized, near-equilibrium plasma is obtained as an integral expression involving its initial value and the one- and two-particle propagation functions in velocity space. The time derivative of this equation is shown to be the kinetic equation derived independently by Balescu and Lenard linearized about thermal equilibrium. The integral expression is further simplified by expressing the two-particle propagator as a functional of the one-particle propagator. (auth)

44882 EFFECT OF FINITE ION GYRO-RADIUS AND FINITE RESISTIVITY ON HYDROMAGNETIC WAVES. R. J. Bickerton (Culham Lab., Abingdon, Berks, Eng.). J. Nuclear Energy, Pt. C, 6: 477-82(Sept.-Oct. 1964).

The effect of finite ion Larmor radius on the propagation of hydromagnetic waves and on the pentration of magnetic field into plasma is derived. (auth)

44883 LANGMUIR PROBE MEASUREMENTS IN THE ASSOCIATED ELECTRICAL INDUSTRIES LEVITRON. D. Balfour (International Research and Development Co. Ltd., Newcastle-upon-Tyne, Eng.). J. Nuclear Energy, Pt. C, 6: 483-92(Sept.-Oct. 1964).

Langmuir double-probe measurements in the Levitron toroidal hardcore pinch experiment are described for different discharge conditions. Radial distributions of ion density as a function of time are presented, and the varia-

tion of the line density of charged particles as a function of time is derived. The effect of preionizing the gas by means of an oscillatory discharge is discussed, and pinch and inverse pinch modes of operating the Levitron are compared in terms of the probe results. Under all conditions, an experimental loss of particles is noted. Fluctuations in ion density and the variation of these fluctuations in space and time are taken as evidence of a remaining instability. The results are discussed in terms of stability theory. (auth)

44884 REMARKS ON THE FINITE LARMOR RADIUS STABILIZATION THEORY FOR MIRROR MACHINES. L. G. Kuo, E. G. Murphy, M. Petravic, and D. R. Sweetman (Culham Lab., Abingdon, Berks, Eng.). J. Nuclear Energy, Pt. C, 6: 505-10(Sept.-Oct. 1964). (CLM-P-39)

Several existing theoretical treatments of the low-frequency drift instability for low-β and low-density plasmas in mirror machines are compared. The importance of boundary conditions is pointed out, and it is shown that finite Larmor radius stabilization is important for the $m = 1$ mode. The equation for the electrostatic potential for high densities is solved for some ratios a/r_0 of the Larmor radius to the plasma radius. It is found that in the Phoenix experiment, under the present operating conditions, a ratio of $a/r_0 \geq 0.5$, corresponding to the field of ≤5 kgauss is sufficient for stability. (auth)

44885 MASS-CONJUGATE INSTABILITIES. R. A. Dory (Midwestern Universities Research Assn., Madison, Wis.). J. Nuclear Energy, Pt. C, 6: 511-12(Sept.-Oct. 1964).

Mass-conjugate systems (positive- and negative-mass systems that behave identically with the exception that particle excesses in one case are identified with particle deficiencies in the other) are postulated. The usual negative-mass and two-stream unstable systems occur in approximately conjugate pairs. (D.C.W.)

44886 AMBIPOLAR SCATTERING LOSSES FROM MAGNETIC MIRRORS. T. K. Fowler and M. Rankin (Oak Ridge National Lab., Tenn.). J. Nuclear Energy, Pt. C, 6: 513-14(Sept.-Oct. 1964). (ORNL-P-17)

The ambipolar scattering losses in experiments in which the mirror ratio is small were investigated. The enhancement of the losses due to development of a plasma potential was calculated. (D.C.W.)

44887 METHOD OF MEASUREMENT OF ELECTRON TEMPERATURE FROM THE INTENSITY RATIO OF TWO LINES IN A PLASMA DURING THERMODYNAMIC EQUILIBRIUM. Jean-Louis Schwob (Centre d'Etudes Nucleaires, Fontenay-aux-Roses, France). J. Phys. (Paris), 25: 713-18(June 1964). (In French)

A method for measuring the electron temperature in a high temperature, low density plasma with a coronal distribution for the excited levels is described, based on the intensity ratio of two spectral lines of an alkali-like ion. For this purpose, various formulas for the electron impact excitation cross sections are presented and discussed. The curves showing the line intensity ratio versus T_e were drawn for the pairs obtained from the following lines: NV 1 238 Å, NV 209 Å, and NV 162 Å, thereby permitting a measurement of electron temperatures in range from 7 to 70 ev. Some results obtained with this method, for the torus TA 2000 are given. (auth)

44888 MEASUREMENT OF THE VELOCITY OF A SHOCK WAVE BY BLOCKING OF HF TRIODES. Nguyen Van Trong (Faculte des Sciences, Lille). J. Phys. (Paris), 25: Suppl. to No. 6, 87A-9A(June 1964). (In French)

A simple and rapid photoelectric method for measuring the velocity of a self-luminous plasma front in a coaxial plasma shock tube is described. This method eliminates the accidental variations of the photoelectric signal and the perturbations due to the reflected wave. (auth)

44889 THERMONUCLEAR FUSION. W. E. Shoupp. Nucl. News, 7: No. 10, 53-4(Oct. 1964).

A summary is given of the Geneva Conference papers on thermonuclear fusion. (C.E.S.)

44890 GREEN'S FUNCTION FOR SIMPLE BROWNIAN KINETICS AND ITS APPLICATION TO PLASMA. W. A. Janos (North American Aviation, Inc., Downey, Calif.). Nuovo Cimento (10), 34: 371-85(Oct. 16, 1964).

An analysis is outlined concerning the derivation and application of the Green's function for a class of Fokker-Planck equations with strictly time-dependent external fields and constant viscosity-diffusion coefficients, the kinetic equation commonly used in the theory of Brownian motion. The form of Green's function for this general class of partial differential equations is given explicit expression in terms of the collisionless time-development operator on the set of initial velocities under the influence of external fields and viscous force. Application of such a singular solution is made to simplify the formulation for the near-equilibrium kinetics of excitation of neutral atoms by electrons and to electromagnetic propagation problems where a linearized self-consistent field treatment of the electronic constituent of a three-fluid plasma is necessary. (auth)

44891 SINGLE-PARTICLE RADIATION PROCESSES IN A PLASMA WITH MAGNETIC FIELDS. Robert Goldman (Princeton Univ., N. J.) and Ludwig Oster. Phys. Rev., 136: A606-9(Nov. 2, 1964).

From the classical equation of motion, the radiation emitted by an electron in an external magnetic field undergoing Coulomb interactions is derived. It is shown that the several spectral components corresponding to magnetic and Coulomb force terms cannot be interpreted simply by saying that the total spectrum is composed of a cyclotron line superimposed on the continuum from the bremsstrahlung emission in the absence of the magnetic field. (auth)

44892 BEAM-PLASMA INTERACTION EXPERIMENTS AND DIAGNOSTICS. I. Alexeff, R. V. Neidigh, and W. F. Peed (Oak Ridge National Lab., Tenn.). Phys. Rev., 136: A689-95(Nov. 2, 1964). (ORNL-P-49)

Beam-plasma interaction is considered to heat ions and electrons. A deuterium plasma is trapped between magnetic mirrors and traversed by a 5-kv, ½-A electron beam emerging from a highly ionized region in the mirror throat. The interaction amplifies the electron temperature of the plasma until the pressure exerted by the plasma competes with the pressure of the containing magnetic field ($8\pi nKTB^{-2} \approx 1$). Techniques used in measuring the density, temperature, and stability of the plasma are described. (auth)

44893 SUPPRESSION OF CONVECTIVE LOSSES FROM A STEADY-STATE PLASMA BY A POSITIVE-GRADIENT FIELD. C. C. Damm, J. H. Foote, A. H. Futch, A. L. Gardner, and R. F. Post (Univ. of California, Livermore). Phys. Rev. Letters, 13: 464-7(Oct. 12, 1964).

Convective plasma losses in a steady-state experiment were suppressed by a dodecapole array of longitudinal line cusps in combination with a mirror field. The plasma was produced by neutral atom injection; the plasma ion energy was 20 kev. With the convective losses suppressed, evidence for a lower-order density limitation by another in-

stability mechanism was observed. The new limitation is apparently related to the detection of coherent oscillations at the ion gyrofrequency. (D.C.W.)

44894 SOLUTION OF CERTAIN PROBLEMS ON ONE-DIMENSIONAL UNSTABLE MOTION OF A CONDUCTING GAS IN STRONG ELECTROMAGNETIC FIELDS. G. M. Bam-Zelikovich. Prikl. Mat. i Mekhan., 28: 664-9(July-Aug. 1964). (In Russian)

A system of equations for one-dimensional motion of a conducting gas (plasma) in a strong magnetic field in the case of small Reynold's magnetic numbers, was reduced to one equation by selecting corresponding variables. The automodel solution of this equation was analyzed, and a solution was developed for the problem of conducting gas motion in an unlimited channel with magnetic field. (R.V.J.)

44895 THE ROLE OF THE FLUCTUATING VELOCITY DISTRIBUTION IN THE RELAXATION OF CHARGED PARTICLES IN A DISTURBED PLASMA. Noboru Hokkyo (Hitachi Central Research Lab., Tokyo). Progr. Theoret. Phys. (Kyoto), 31: 977-89(June 1964).

A mechanism is suggested for the anomalous deceleration of a charged particle passing through a disturbed plasma in which the velocity distribution function of electrons fluctuates around some smooth function. It is shown by the use of the Nyquist diagram that the effect of the fluctuations (many small humps) in the high energy tail of the velocity distribution function is to give rise to extra wave modes of acoustic type in the medium. The energy loss of a fast particle incident on the disturbed plasma can appreciably be increased due to the excitation of these extra modes in addition to the usual loss associated with the excitation of plasma waves. (auth)

44896 DETERMINATION OF GAS-DISCHARGE CESIUM PLASMA PARAMETERS BY MICROWAVE METHODS. N. D. Morgulis, S. M. Levitskii, and V. A. Panichevskii (Kiev State Univ.). Radiotekhn. i Elektron., 9: 1433-9 (Aug. 1964). (In Russian)

The frequency of electron collisions and the decay rate of weakly ionized plasma were determined by a high frequency resonator method in the 3-cm wave range. Charge concentrations were 10^{11} to 10^{12} cm^{-3} and cesium vapor pressures were 0.01 to 0.2 mm Hg. The obtained data were used for estimating the magnitude of the effective cross section for electron scattering by cesium atoms and the coefficient of dipolar diffusion. The data were also correlated with available published data. (tr-auth)

44897 CROSS MODULATION IN PLASMA WAVEGUIDE. S. M. Levitskii and V. F. Virko. Radiotekhn. i Elektron., 9: 1518-19(Aug. 1964). (In Russian)

Nonlinear phenomena in plasma waveguides were previously described theoretically and were experimentally proved for 10 kc. At superhigh frequencies the nonlinear effect took place with transmission to the waveguide of tens and hundreds of kilowatts. However, another type of nonlinear effect was produced by plasma parameter variations developed by the electric field of a wave propagating in plasma. Such effects were studied using an installation described by J. M. Anderson et al. (Phys. Rev 1955, 100, 4, 1037). A 30-cm long, 1-cm diameter discharge cylinder of saturated mercury vapor was used as a plasma waveguide. The signals were supplied from two generators. The depth of cross modulation as a function of the first generator power, measured at 25-cm from the waveguide, was plotted for 6×10^{-3}mm Hg, f_1 = 500 Mc, f_2 = 440 Mc, F = 1.5 c and M = 10%. The depth of the cross modulation increased with decreasing discharge current (approaching the waveguide cut off point). The spatial distribution of cross modulation, plotted as it moved away from the waveguide, showed increased modulation when the waveguide is nearest the cutoff point. (R.V.J.)

44898 VISCOUS STRESS TENSOR AND THERMAL FLUX IN A TWO TEMPERATURE PARTIALLY IONIZED GAS. M. Ya. Alievskii, V. M. Zhdanov, and V. A. Polyanskii. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 3, 32-42(May-June 1964). (In Russian)

A closed transport equation system previously developed for multicomponent ionized gas in a magnetic field was used for describing the viscous stress tensor and thermal flux vector in a two-component ionized gas. Linear algebraic transport equations were used with the assumption that the parameters of the ionized gas do not vary much at a distance of a free path during the particle collision time. The transport coefficients were reduced for the case of a three-component partially ionized gas with electron temperature differing from the ion and atom temperature. Expressions were derived for coefficients of viscosity and heat transfer of a two-temperature gas in a magnetic field. (R.V.J.)

44899 HEAT TRANSFER AND DIFFUSION IN A PARTIALLY IONIZED TWO-TEMPERATURE PLASMA. G. S. Bisnovatyi-Kogan. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 3, 43-51(May-June 1964). (In Russian)

A Chapman-Ensk method was used for deriving a solution for the Boltzmann equation describing a plasma in a magnetic field. A partially ionized plasma with the electron temperature varying from the temperature of the heavy particles was considered. Tensors binding the heat flux and diffusion velocities with temperature gradients and diffusion vectors were found. (tr-auth)

44900 ON APPLICABILITY OF VARIOUS EQUATIONS FOR AN INVESTIGATION OF COMPLETELY IONIZED GAS. V. B. Baranov. Zh. Prikl. Mekhan. i Tekhn. Fiz., No. 3, 52-9(May-June 1964). (In Russian)

44901 BOUNDARY CONDITIONS ON PLASMA SURFACE WITH SHARPLY CHANGING PARAMETERS. E. N. Vasil'ev, Yu. I. Orlov, and V. A. Permyakov (Inst. of Power Engineering, Moscow). Zh. Tekhn. Fiz., 34: 1341-4(Aug. 1964). (In Russian)

Approximations of boundary conditions on a plasma surface were developed for ϵ and σ variations normal to the surface. An ordinary plane wave model was used for analyzing the problem of electromagnetic wave incidence on heterogeneous plasma. It was assumed that the electron concentration varies linearly along a normal to the interface, and the number of collisions is not a function of coordinates. Equations were obtained for polarization where the vector E is parallel to the interface and where E is in the plane of incidence. (R.V.J.)

44902 ON ONE APPROXIMATION IN THE THEORY OF ORDINARY WAVE PROPAGATION IN PLASMA IN A STRONG MAGNETIC FIELD. B. N. Gershman. Zh. Tekhn. Fiz., 34: 1351-3(Aug. 1964). (In Russian)

An approximation was developed for electromagnetic wave propagation in a homogeneous plasma in a constant magnetic field. The obtained approximation for the ordinary waves exhibited an analogy to Alfven wave propagation. (R.V.J.)

44903 THE SOLUTION FOR A PROBLEM OF TRANSITORY RADIATION FROM A PLASMA-LIKE MEDIUM. A. Ts. Amatuni. Zh. Tekhn. Fiz., 34: 1354-64(Aug. 1964). (In Russian)

A solution is developed for transitory radiation from a

plasma-like medium, where a medium with considerable spatial dispersion is considered to be plasma-like. Various solutions reported in published literature are analyzed, and additional formulas are developed for the mirror image case. (R.V.J.)

44904 THE INFLUENCE OF A WEAK STATIONARY TURBULENCE ON FAST PLASMA PARTICLES. I. S. Danilkin and V. N. Tsytovich. Zh. Tekhn. Fiz., 34: 1365-73(Aug. 1964). (In Russian)

The behavior of fast plasma particles in the presence and absence of strong external electric fields (E_0) was studied. The influence of stationary noise on fast particles at E = 0 was studied for a wide range of spatial spectra with symmetric axes. Plasmas with $T_e = T_i$ and $T_e \gg T_i$, with excited ion-sonic oscillations, were analyzed. It is shown that the mean force acting on a plasma particle may have different signs, depending on the noise distribution. The effect of stationary turbulence on the initial stages of plasma conductivity in a strong electric field was investigated. (tr-auth)

44905 DISPERSION EQUATION FOR ELECTRON FLUX IN PLASMA IN THE PRESENCE OF MAGNETIC FIELD. K. S. Karplyuk and S. M. Levitskii. Zh. Tekhn. Fiz., 34: 1374-9(Aug. 1964). (In Russian)

Components of the dielectric penetrability tensor in plasma transversed by an electric flux in the presence of a longitudinal magnetic field were estimated. The calculations were carried out considering transverse motion of plasma electrons, flux electrons, and electron collisions with gas molecules. The magnitude of the dielectric penetrability tensor was to construct equations for a plasma-flux system in a metallic tube with ideally conducting walls. The influence of a dielectric layer between the plasma and the wall was considered for the case of slow waves (phase velocity slower than c). (tr-auth)

44906 WAVE CONVERSION ON THE BOUNDARY BETWEEN TWO PLASMA MEDIA. Ts. D. Loladze and N. L. Tsintsadze. Zh. Tekhn. Fiz., 34: 1380-6(Aug. 1964). (In Russian)

Conversion of waves from one type to another at the boundary of two plasma media and the effects of ion motion on low frequency plasma oscillations were studied. Ordinarily ion motion does not influence plasma oscillations when the wave velocity in the plasma is higher than the mean square thermal velocity of electrons. In a case in which the wave phase velocity is smaller than the electron thermal velocity, then ion oscillations play a considerable part in low-frequency oscillation induction. An analysis was made of ion motion, and wave incidence, and sources of high frequency, low frequency, and transverse waves. Coefficients of wave conversion from one type to another were calculated, and amplitudes of all outgoing waves were determined. Special cases of high and low frequency wave incidence on the boundary were studied, and the angle of incidence necessary for simultaneous excitation of all three possible oscillations was estimated. (R.V.J.)

44907 CHARGED PARTICLE MOTION ALONG THE AXIS OF A CHANNEL FILLED WITH A MOVING DIELECTRIC . S. N. Stolyarov (Lebedev Inst. of Physics, Moscow). Zh. Tekhn. Fiz., 34: 1396-1400(Aug. 1964). (In Russian)

Formulas were obtained for charged particle fields in a cylindrical channel, and calculations were made of the energy losses by charged particles and particle clusters moving in a dielectric. The equations can be used for calculating plasma bunch acceleration. (tr-auth)

44908 MOTION OF PLASMA BUNCHES IN EXTERNAL MAGNETIC FIELDS. G. A. Delone and M. M. Savchenko (Lebedev Inst. of Physics, Moscow). Zh. Tekhn. Fiz., 34: 1409-16(Aug. 1964). (In Russian)

Longitudinal, transverse, and quadrupole magnetic fields were used in an attempt to reduce particle scattering and losses from plasma bunches. It is shown that the shape of the plasma bunch changes little and particle loss is small only in a quadrupole field. A lack of axial symmetry was observed in bunch motion in a longitudinal field, and there was a strong dependence of motion in a transverse field on the mutual field and current orientation. (tr-auth)

44909 ENERGY SPECTRA OF CONICAL ELECTRODE PLASMA SOURCE. A. A. Kalmykov, V. I. Tereshin, and N. S. Poltavtsev. Zh. Tekhn. Fiz., 34: 1424-31(Aug. 1964). (In Russian)

Energy spectra of particle bunches found in a conical plasma source with a spiral reverse-current and a pulsed gas inlet were investigated. Measurements with a time-of-flight mass spectrometer indicated two modes of source operation which are determined by the selection of time delay between the initial charge and the initial gas inlet into the source. In the first operation, carried out with sufficiently high time delay, the probable proton and ion bunch mixtures do not exceed 30 to 40 ev. At small time delay values (<200 μsec) there appeared another group of high energy protons with a probable energy of 2.5 to 3 ev. (R.V.J.)

44910 ON THE ELECTRIC FIELD INTENSITY IN A LONG HIGH-PRESSURE CYLINDRICAL ARC. R. V. Mitin. Zh. Tekhn. Fiz., 34: 1466-70(Aug. 1964). (In Russian)

A formula binding electric feed intensity in an arc column to current, pressure, and arc radius was obtained using the approximation equations for energy and Ohm's law balance in a plasma confined in a long, high-pressure (argon or helium) arc column. (R.V.J.)

44911 ACCELERATION OF PLASMA DIFFUSION IN ION CYCLOTRON RESONANCE. M. P. Vasil'ev, L. I. Grigor'eva, B. I. Smerdov, and V. V. Chechkin. Zh. Tekhn. Fiz., 34: 1531-3(Aug. 1964). (In Russian)

An analysis was made of data on hydrogen plasma dissociation in longitudinal quasi-stationary, magnetic, and azimuthal high frequency electric fields. Measurements at the 8.1-mm wavelength showed that the rate of plasma decay at particle densities of 1.7×10^{12} to 2×10^{12} cm^{-3} is not a function of field intensity when $H \gtrsim 1.5$ k Gauss. The insensitivity of the plasma decay rate to magnetic field at large H is a result of electron-ion recombination and not diffusion. The rate of plasma decay at particle densities from 7.6×10^{12} to 2.5×10^{12} cm^{-3} was also analyzed as a function of high-frequency field. At all examined hydrogen pressures plasma decay was accelerated in the presence of a high frequency field. (R.V.J.)

44912 ELECTRON TEMPERATURE AND CONDUCTIVITY OF PLASMA IN A HIGH CURRENT TOROIDAL DISCHARGE. B. V. Galaktionov, K. A. Dolmatova, and M. M. Larionov (Ioffe Inst. of Physics and Tech., Leningrad). Zh. Tekhn. Fiz., 34: 1533-5(Aug. 1964). (In Russian)

The relation between electron temperature and plasma conductivity in a turbulent discharge was studied using the Alpha installation. The electron temperature was determined from the energy distribution using a triple screen electrostatic analyzer and from plasma noise emission at superhigh frequencies. Simultaneous measurements were made of the currents in the discharge and in the chamber. The electron temperature and plasma conductivity were plotted as functions of hydrogen pressure. (R.V.J.)

44913 ON THE NON-LINEAR THEORY OF CHERENKOV ENERGY LOSSES BY CHARGED PARTICLE CLUSTERS IN PLASMA. V. I. Miroshnichenko (Khar'kov Inst. of Physics and Tech.). Zh. Tekhn. Fiz., 34: 1537-40(Aug. 1964). (In Russian)

Effects of nonlinear properties of plasma, in a metallic waveguide with a constant magnetic field along the axis on Cherenkov losses by charged particles were investigated. It is shown that in linear approximation the energy losses are a function of the sign of the charge. (tr-auth)

44914 ON THE GENERATION OF SOLAR RADIO BURSTS. S. F. Smerd (Commonwealth Scientific and Industrial Research Organization, Sydney). p.343-55 of "Physics of Solar Flares," NASA-SP-50.

Some properties of waves, plasmas, and their interactions needed in a study of production mechanisms of solar radio bursts are discussed. (R.E.U.)

44915 RADIOFREQUENCY RADIATION AND PARTICLE ACCELERATION FROM SOLAR FLARE FILAMENTS DUE TO COLLECTIVE MOTION AT MULTIPLES OF THE CYCLOTRON FREQUENCY. Richard L. Moore and J. R. Johnston (Douglas Aircraft Co., Inc., Long Beach, Calif.). p.371-6 of "Physics of Solar Flares," NASA-SP-50.

A mechanism is proposed through which the turbulent energy of a plasma is converted into induction and traveling r-f fields. The mechanism is the rotational collective motion of an ion or electron gas in a magnetic field at both the plasma frequency and multiples of the cyclotron frequency. A cylindrical ring of the gas involved is assumed to have its macroscopic angular velocity equal to the cyclotron frequency. Coupling between the convective terms of the acceleration field and the electromagnetic potentials results in waves rotating around the axis whose intensity is given by the turbulence intensity. These current waves emit r-f radiation, which, as it travels outward, also travels around the axis at angular rates that are (1) integral fractions of the plasma frequency, or (2) the cyclotron frequency. Combined with the magnetic field external to the filament, the waves can accelerate particles to high energy. Properties that the filament must have and a preliminary comparison with experiment are given. (auth)

44916 ELECTROMAGNETIC RADIATION FROM PLASMA OSCILLATIONS. Ludwig Oster and M. Altschuler (Yale Univ. Observatory, New Haven). p.377-81 of "Physics of Solar Flares," NASA-SP-50.

The general nature of a mechanism that would be able to produce electromagnetic radiation of the kind observed in type III bursts is determined. This mechanism is shown to be a generalized bremsstrahlung mechanism whose spectral features are computed numerically in the single-particle limit. Refinements that permit relating the remaining observational details to the particulars of the exciting stream are described. (auth)

Shielding

Refer also to abstract 44981.

44917 (NUC-E-15) EVALUATION OF THE SHIELDING CHARACTERISTICS OF STRUCTURES FOR SIMULATED RESIDUAL RADIATION. Final Report. L. Degelman, A. Foderaro, and G. Kowal (Pennsylvania State Univ., University Park). Nov. 1963. Contract Da18-108-AMC-24-A. 64p. (AD-432876)

A semi-empirical expression was developed for the gamma dose rate at any point within a concrete structure resulting from a point isotropic source lying anywhere on the ground outside the structure. This point-to-point kernel was integrated over an infinite area to check existing theories of fallout protection and to determine the variation of dose rate as a function of position within the structure. (auth)

44918 (ORNL-P-311) DENSITY INTERFACE EFFECTS ON INITIAL RADIATION FROM NUCLEAR WEAPONS. J. A. Auxier (Oak Ridge National Lab., Tenn.). [1963]. Contract W-7405-eng-26. 12p. (CONF-706-1)

From NAS Shielding Subcommittee on Civil Defense, San Francisco, Apr. 1964.

Gamma and neutron dose measurements were made for a small bare reactor suspended on a tower at 27 to 1500 ft with detector heights of 0 to 100 ft and source detector separation of 3 to 1500 yards. The ORNL Health Physics Research Reactor was used as the source, and was suspended from the BREN tower. A ^{60}Co source was also suspended for gamma dose buildup measurements for water. (R.E.U.)

44919 INSIDE ROTATION IN HEAVY NUCLEI. S. G. Ryzhanov. Analele Stiint. Univ. "A. I. Cuza" Iasi Sect. I, 8, No. 1, 127-30(1962). (In Russian)

The complex system of the energy levels of ^{214}Po is considered according to the scheme of inside rotation. The rotational constants and the frequency of rotation are defined from the empirical facts. The height of the barrier of the slow down rotation is calculated for α-particles of the nuclei field of force. (auth)

44920 MEASUREMENT OF THE QUANTITY AND QUALITY OF SCATTERED RADIATION. F. Wachsmann, H. Tiefel, and E. Berger (Universitat, Erlangen, Ger.). Fortschr. Gebiete Roentgenstrahlen Nuklearmed., 101: 308-17(Sept. 1964). (In German)

An account is given of measurements of quantity and quality of scattered radiation which is emitted by various substances under defined geometrical conditions. The energy of the primary radiation is varied in fine steps between 15 kev and 17 Mev. It was established that quantity as well as quality (h.v.t.) depend on the energy of the primary radiation and on the atomic number of the scattering substance in a complex way, which on purely theoretical grounds can be explained only with some approximation. Within the diagnostic range iron proves to be particularly favorable and it may be adequate to cover the protective walls with thin layers of iron. Some aspects of the significance of scattered radiation for protection are discussed. (tr-auth)

44921 ON THE SPECTRUM OF γ-QUANTA FROM A PRIMARY ELECTRON IN MEDIA OF INFINITE DIMENSIONS. D. I. Sikora (Uzhgorodsk State Univ., USSR). Ukr. Fiz. Zh., 9: 697-701(July 1964). (In Ukrainian)

Approximation methods were used for calculating the γ-spectra from a primary 24-Mev electron in infinite media of water, copper, and lead. The theoretical yields of photoneutrons, obtained by calculated spectra, agree with the experimental data within the limits of absolute errors. A comparison is made with the Belenky–Tamm theory. (auth)

REACTOR TECHNOLOGY

General

44922 (ANL-6800(p.326-402)) REACTOR SAFETY. (Argonne National Lab., Ill.).

The experimental program to determine rates of reaction of molten reactor fuel and cladding metals with water is continuing. One method uses the energy contained in the light beam from a ruby laser to heat single particles of metal in a water environment. The experiment is designed to study not only the chemical reaction of particles with water, but also to study the transient energy exchange and associated hydrodynamic effects. The technique was developed so that small metal foil squares of Zr stainless steel, Pt, and Al can be reproducibly heated to form molten spheres. The extent of chemical reaction is determined by microanalysis of the quantity of H_2 generated in a closed quartz cell and by metallographic determination of the oxide film thickness. The rates of reaction and heat transfer will be determined from transient temperature measurements using an electronic two-color optical pyrometer and from transient measurements of the thickness of the steam–H_2 film from high-speed motion pictures. Laboratory studies of the kinetics of isothermal metal-steam reactions were extended to include U from 1200 to 1600°C and Mo from 1100 to 1700°C. Both studies were performed by a method in which steam, at one atmosphere, was passed over induction-heated cylindrical specimens. The progress of reaction was observed by continuous measurement of the volume of H_2 generated. U, which is molten above 1133°C, was supported on a quartz pedestal and retained its shape because of the strength of an oxide film which formed. Reaction rates for U followed the parabolic rate law and yielded an activation energy of 25 kcal/mole. The results, however, were complicated by the poor thermal conductivity of the oxide film, which resulted in a large temperature gradient across the oxide film. The studies of the kinetics of the Mo–steam reaction were undertaken to determine the suitability of Mo as a structural material for experimental apparatus to be operated at high temperatures in steam. The Mo–steam reaction, unfortunately, was found to be very rapid at the higher temperatures studied. The reaction followed a linear rate law with an activation energy of 54 kcal/mole. The reaction occurs with the evolution of volatile MoO_3. Laboratory studies of the high-temperature combustion of Al and Mg in water were also carried out. Al, when heated to 1750°C in air, ignites and burns vigorously by a vapor phase mechanism. Burning pellets dropped into water continue to burn beneath the water surface and later at the water surface. A series of experiments were performed to determine the combustion rate of Al as a function of pellet size. The consumption time was found to be a linear function of pellet dia. Reaction under water occurred at a rate of 0.96 g Al consumed/(sq cm) (min). Experiments with Mg were performed by heating a bottom-tapped crucible of Mg to 700°C and discharging the molten metal through an Ar atmosphere into a water pool. The reaction rate was determined by taking motion pictures of the displacement of water level (in a gas burette) that resulted from the chemical generation of H_2. If the Mg–water reaction is compared with the Al–water reaction at equal metal vapor pressures, a physical similarity of the reactions is apparent. Both appear to be vapor phase combustion processes, although the Mg reaction rate is much the faster. Studies of metal-water reactions initiated by a nuclear transient were continued. In these studies, small fuel specimens were submerged in water in high-pressure autoclaves which were then placed at the center of TREAT and subjected to severe nuclear transients. Four experiments were performed with small plates of 89.35 wt % Zr–10.65 wt % U (93% enriched). The results showed that, in general there was only a minor effect of water temperature and steam overpressure. This was in contrast with the marked effect of water temperature noted previously with Al–U alloy material. An experimental program has begun in which specimens of preirradiated fuel are melted and dispersed in water by a nuclear transient in the Transient Reactor Test Facility (TREAT). The purpose of the program is to determine the effect of preirradiation on the extent of metal-water reaction and on the dispersion behavior during fuel meltdown. The fidelity with which transient pressure was recorded by a pressure transducer located at a distance from an autoclave containing a TREAT experiment was studied briefly. The results showed that a transducer located at the end of a tube 15 ft long would satisfactorily record pressure-time events in TREAT experiments. Studies of the oxidation and ignition of Pu are continuing. Isothermal oxidation studies were extended to a higher temperature range in order to interpret ignition results. Experiments were performed up to 550°C with negligible self-heating. The reaction initially followed a parabolic rate law and subsequently followed a linear rate law at these high temperatures. Isothermal oxidation studies with a Pu–2 at. % Al alloy were initiated because of the beneficial effect of Al addition (i.e., a higher ignition temperature) noted in previous ignition studies. Experiments conducted at 240 through 490°C indicated that the oxide which was formed on the Al alloy was more protective than the oxide formed on unalloyed Pu. The effect was more marked at lower temperatures. Isothermal oxidation experiments were also carried out with 99.84 at. % Pu. Results were identical with those obtained with Pu which had nearly 10 times the impurity content of the high-purity material. Previous studies of the isothermal oxidation of Pu had shown that a change of oxidation mechanism occurs between 300 and 400°C, so that there is a minimum in the oxidation rate at approximately 420°C. A specimen was oxidized at 438°C to form the protective oxide, the temperature was then reduced in steps, and the reaction rate was determined at each step. Results indicated that oxidation rates were lowered by a factor of 9 to 50 at 150 to 350°C. A series of experiments were completed to determine the effect of moisture on the ignition and oxidation behavior of Pu in air. Ignition temperatures were determined by burning curve experiments for two Pu samples in air saturated with water vapor at room temperature. The Pu samples were a 5-mm cube and a 0.11-mm thick foil. The ignition temperatures were essentially identical to those found previously in dry air. Programs of research on the ignition behavior of alloys have been completed. In one of the programs, binary alloys consisting of Pu and about 2 at. % of another element were studied. Typical impurities and elements of varied valence were used as the second constituent in the Pu alloys. The alloys, contain-

ing Al, C, Ce, Cr, Co, Fe, Mn, Ni, and U, were formed into a series of 5-mm cubes and foils of various sizes. The ignition temperature of these specimens was then determined by the burning curve method. Major effects were shown by the Al, Ce, C, and Co additives, which raise the ignition temperatures of foil specimens (high specific area) from 150 to 250°C above that of unalloyed Pu. The other program was concerned with ternary alloys containing about two parts of U to one part of Pu and about 6 at. % of a third element. Interest in these alloys is based on the need for a 2:1 U–Pu alloy for zero power critical experiments. Ternary alloys which were prepared, contained Al, C, Cu, Fe, Mo, and Zr as the third element. Alloys containing Al, Cu, C, and Zr were found to have undesirable ignition behaviors, although none were as poor as the behavior of a sample of U–Pu alloy without a third component. Good resistance to ignition was achieved with alloys containing Fe or Mo; however, the ignition characteristics of the Fe alloy were adversely affected by the presence of moisture in the air. An investigation of the thermal conductivity of metal powders was initiated in order to achieve a better understanding of powder ignition phenomena. Measurements were accomplished using a line source heating method. Preliminary results were obtained with spherical powders of Ni and U. Experimental variables included particle size, pressure, temperature, and extent of oxidation. Studies were resumed of the Al–U_3O_8 thermite reaction. Experiments were performed with cold-pressed compacts of Al–U_3O_8, containing 30, 45, 60, 75, and 90 wt % U_3O_8 and with unenriched Argonaut fuel plates which contain 39 wt % U_3O_8. Results showed that a maximum thermal effect occurred for specimens in the composition range 60 to 75 wt % U_3O_8 and that there was no effect of environment, air or Ar, or of 3 wt % water added to the pellets. (auth)

44923 (ANL-6923) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, JULY 1964. (Argonne National Lab., Ill.). Aug. 20, 1964. Contract W-31-109-eng-38. 95p.

Summaries are presented on developments in boiling water reactors, liquid-metal-cooled reactors, general reactor technology, advanced systems research and development, and nuclear safety. Separate abstracts were prepared for each section. (J.R.D.)

For abstracts of individual sections see: 44924, 44925, 44926, 44927, and 44928.

44924 (ANL-6923(p.1-13)) BOILING WATER REACTORS. (Argonne National Lab., Ill.).

Operations, experimental programs, water chemistry studies, and maintenance work in Borax-V are summarized. (J.R.D.)

44925 (ANL-6923(p.14-45)) LIQUID-METAL-COOLED REACTORS. (Argonne National Lab., Ill.).

Studies of Assembly 45 in ZPR-III are described. Data on the critical material and physical parameters of ZPR-IX Assembly 4 are tabulated along with data on the central worth coefficients on several metallic and ceramic materials and separated W isotope samples. Investigations are reported on the properties of U–Pu–fissium alloys, Ti–V jacket materials, radiation effects on Nb–Zr-clad U–Pu–fissium alloys, fabrication and properties of fuel elements for zero-power reactors, fabrication of Doppler test elements, development of Pu–U–C fuels, corrosion of Croloy in high-temperature air, reactions of Cd–Mg–Zn alloys with U_3O_8 at 600°C, distribution of Pu between Mg–Zn alloys and molten chloride salts, head-end treatment of refractory fuels, and sodium coolant chemistry. Other work is reported on development and operation of EBR-II and FARET. (J.R.D.)

44926 (ANL-6923(p.46-78)) GENERAL REACTOR TECHNOLOGY. (Argonne National Lab., Ill.).

Progress is reported on high-conversion critical experiment, in-core fast neutron spectroscopy, theoretical reactor physics, development of high-temperatrue ceramic fuel materials, corrosion of Zr by liquid Na, dissolution of stainless steel by Bi–Sn eutectics, development of thorium-base fuels, reactor materials development, development of remote control systems, heat engineering, chemical separation processes, and development of Plutonium Recycle Reactor. (J.R.D.)

44927 (ANL-6923(p.79-85)) ADVANCED SYSTEMS RESEARCH AND DEVELOPMENT. (Argonne National Lab., Ill.).

Summaries are presented of core physics calculations, core design work, design work on beam tubes for the experimental facility, and critical experiments for the Argonne Advanced Research Reactor. Other work is reported on MHD studies with liquid metals and on regenerative EMF cells. (J.R.D.)

44928 (ANL-6923(p.86-92)) NUCLEAR SAFETY. (Argonne National Lab., Ill.).

Safety studies are described for thermal and fast reactors. Emphasis is placed on studies of metal–water reactions, metal oxidation studies, meltdown experiments, pressure-pulse studies in vaporizing liquids, and tests of a meltdown scanning device. (J.R.D.)

44929 (ANL-6936) REACTOR DEVELOPMENT PROGRAM PROGRESS REPORT, AUGUST 1964. (Argonne National Lab., Ill.). Sept. 15, 1964. Contract W-31-109-eng-38. 90p.

Summaries are presented of developments in boiling-water reactors, liquid-metal-cooled reactors, general reactor technology, advanced systems, and nuclear safety. Separate abstracts were prepared for the 5 topics. (J.R.D.)

For abstracts of individual sections see: 44930, 44931, 44932, 45079, and 45080.

44930 (ANL-6936(p.17-38)) LIQUID-METAL-COOLED REACTORS. (Argonne National Lab., Ill.).

Doppler measurements in ZPR-III are reported for ^{239}Pu–^{238}U metallic fuel mockups and urania–plutonia test samples. Axial flux transverses were made by the foil-activation technique in a 600-liter core containing U, Na, and graphite with a length-to-diameter ratio of about 1 to 1. Spatially dependent worth studies were made on Rh reflectors in ZPR-IX, along with studies of B worth enhancement by H and measurements of central worth coefficients of Au, Zr, and ZrH_4. Development work on Ti–V cladding materials is described, and preliminary corrosion tests of V-base binary alloys are reported. Developments in fast-reactor fuel processing are also reported. EBR-II measurements made during the period included heat balance and transfer functions in approach-to-power experiments and power and flow coefficients. Analyses of the Ar cover gas system in EBR-II revealed that about 2200 PPM He and 20 PPM H_2 were present. Operation of the EBR-II power plant is summarized. Development and operation of the fuel-cycle facility and FARET are reported. (J.R.D.)

44931 (ANL-6936(p.39-72)) GENERAL REACTOR TECHNOLOGY. (Argonne National Lab., Ill.).

Measurements of mass-energy relations in 6.0-Mev neutron fission of ^{235}U are presented, and developmental work on an automated facility for total neutron cross section measurements is summarized. Data on the reactions $^{9}Be(d,n)^{10}B$, $^{27}Al(d,n)^{28}Si$, and $^{19}F(d,n)^{10}B$, $^{27}Al(d,n)^{28}Si$, and $^{19}F(d,n)^{20}Ne$ were obtained along with data on fast neutron scattering from Ta, W, Re, and Tl. Summaries of work are included on high-conversion critical experiment, matrix representation of detection systems, effective cross sections for reflectors, resonance interference, total neutron cross sections, interpretation of Rossi-alpha data, ceramic fuels, Zr corrosion-film stripping, corrosion of Fe and Ni alloys by steam, heat engineering, fluidization and volatility separation processes, and Pu recycle program. (J.R.D.)

44932 (ANL-6936(p.77-80)) NUCLEAR SAFETY. (Argonne National Lab., Ill.).

Thermal reactor safety studies are summarized. Information is included on Al–water reactions and urania reactions in TREAT. In fast reactor safety studies, efforts were devoted to in-pile oxidation experiments. Developments in the large TREAT loop are discussed. (J.R.D.)

44933 (NP-14367) SUMMARY OF ACTIVITIES, JULY 1963–JULY 1964. (Reactor Centrum Nederland, The Hague). 15p.

The development and performance of power and research reactors in the Netherlands are summarized. Information is included on the following reactors: PUK, NERO, NEREUS, KRITO, Low Flux Reactor, High Flux Reactor, BARN, and KSTR. (N.W.R.)

44934 (TID-7697(p.5.4.1-21)) A SEMI-EMPIRICAL DETERMINATION OF FAST AND INTERMEDIATE NEUTRON FLUX SPECTRA IN A REACTOR. J. P. Genthon (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay).

Current methods for the determination of fast and intermediate neutron fluxes are reviewed. A general formulation $\psi(E)$ of the energy distribution of the fluxes $\phi(E)$ is given which is valid for most thermal reactors. The application of the formulation to heavy-water, light-water, and graphite reactors is discussed. Some comparisons with experimental results are discussed. (D.L.C.)

44935 A REACTIVITY METER AND ITS APPLICATION. Eiji Suzuki and Tomio Tsunoda (Nippon Atomic Industry Group Co., Kawasaki and Kanagawa, Japan). J. Nucl. Sci. Technol. (Tokyo), 1: 210-18(Sept. 1964).

In order to measure reactivity from instant to instant during reactor operation, real time computation based on reactor kinetic equations must be made. Some reactivity meters capable of such computation based on the analog computer technique were developed. After their characteristics were checked by an analog computer and a kinetic simulator, they were applied to reactor experiments and operation. It was found that the reactivity meter method for measurement of reactivity worth (especially for control rod calibration) is better than other current methods, and the reactivity meter can also serve as a tool in nuclear instrumentation of reactors for its ability to indicate reactivity even in reactor start up conditions. (auth)

Auxiliaries and Components

Refer also to abstracts 43885, 43899, and 45019.

44936 (GEMP-84) REACTOR INSTRUMENTATION AND CONTROL PROGRESS REPORT NO. 84. (General Electric Co. Advanced Technology Services, Cincinnati). Sept. 30, 1964. Contract AT(40-1)-2847. 21p.

The capacitance temperature sensor for reactor environments depends upon a change of dielectric constant of alumina, beryllia, or other ceramic materials with respect to temperature. A two-element, beryllia–molybdenum, probe at temperatures up to 1900°C is tested. The integrated 1650°C probe and readout system, including the use of a single-crystal alumina sensing element, are described and evaluated. Advanced nuclear sensors for general use in the nuclear industry for monitoring and controlling high-temperature, high-performance reactors are developed. Fabrication of all components for a 60-cps regulating rod control system is discussed. The system is tested using a servomotor-powered actuator and a simulated reactor. The shutdown unit and servodrive amplifier are tested. A high-temperature compensated chamber is tested at 500°C. The investigation of anodized coatings and magnetic fields to retard low-energy secondary electrons, in order to improve charged fragment neutron detector performance, is still in progress. (N.W.R.)

44937 (ANL-Trans-79) ELIMINATION OF APERIODIC TERMS IN PILE OSCILLATOR MEASUREMENTS. Rolf Persson (Aktiebolaget Atomenergi, Stockholm). Translated for Argonne National Lab., Ill.), from report RPM-RFX-228, Apr. 25, 1963. 5p.

A method is described for evaluation of pile oscillator measurements made with drift in the reactor's effective level. The signal, which is obtained from a voltage-to-frequency converter, is integrated directly over successive quarter periods. (R.E.U.)

44938 INCIPIENT BOILING DETECTOR. C. A. Mossman. Nucl. Safety, 5: 372(1964).

A report that describes an ultrasonic boiling and cavitation detector for use in anticipating incipient boiling in pressurized-water reactors is reviewed. (J.R.D.)

44939 REACTOR FUSES. J. R. Tallackson. Nucl. Safety, 5: 372-4(1964).

Developments of reactor fuses based on U shear pins and on rupture diaphragms are reported. The shear pins are used to hold fused fuel elements in the case until a severe excursion causes them to fail allowing the fused elements to fall free of the core. The diaphragm safety device acts as a fuse that releases high-pressure BF_3 into a high-importance core area during excursions. (J.R.D.)

44940 INSTRUMENT SYSTEM TESTING FOR IN-PILE LOOPS. K. W. West. Nucl. Safety, 5: 374-7(1964).

A review of the instrumentation required in in-pile experiments to provide the required degree of protection and furnish desired serviceability is presented. Aspects of scheduled instrument testing are discussed along with fundamental types of in-pile-loop safety systems. (J.R.D.)

44941 A SIMPLE, COMPACT ROD DRIVE USING A STEPPING MOTOR. Edward F. Groh and Charles E. Cohn (Argonne National Lab., Ill.). Nucl. Sci. Eng., 20: 290-7 (Nov. 1964).

A rod drive using a stepping motor has been developed for the Argonne Advanced Research Reactor critical experiment. The control rod is suspended from a roller chain which meshes with a sprocket driven by the motor. Rod position is indicated by counting the number of steps. Scram is produced by interrupting the power to the motor windings, thus removing the motor's holding torque. (auth)

44942 STANDARDIZATION OF ELECTRONIC EQUIPMENT FOR NUCLEAR REACTORS. G. Lapicque and J. Serriere (Centre d'Etudes Nucleaires, Saclay, France). Onde Elec., 44: 730-2(July-Aug. 1964). (In French)

Studies on the standardization of electronic equipment for reactors is being done by the French and the Commission Electrotechnique Internationale. The French group has published general mechanical and electrical specifications for the equipment. The C.E.I. can only give recommendations, lacking in the detail possible in the Frlench specifications. These, however, are being published. (J.S.R.)

44943 SOME RECENT DEVELOPMENTS IN THE FIELD OF FLUX DETECTORS FOR CONTROL OF REACTORS. J. Duchene (Centre d'Etudes Nucleaires, Saclay, France). Onde Elec., 44: 733-6(July-Aug. 1964). (In French)

Some devices that illustrate general trends in the development of control detectors are described. These include fission chambers for neutron flux measurement for operation at high or average temperature with minimal activation, ionization chambers for measurement of high gamma flux in the presence of high neutron flux, fission chambers with fast pulse measurement of neutron flux, coaxial cable for use at high temperature and high flux, and electrical insulation for the detectors. (tr-auth)

44944 A PERIOD METER WITH VARIABLE TIME CONSTANTS. C. Faraguet and R. Quénée (Centre d'Etudes Nucleaires, Saclay, France). Onde Elec., 44: 748-51(July-Aug. 1964). (In French)

The optimum transfer function for a period meter and the theoretical results obtained are reviewed. On this basis, the principle of a period meter with variable time constants, which would conserve a practically constant noise output and would respond in the minimum compatible time, is indicated. The electronic circuits making possible the construction of such a device are described. (tr-auth)

44945 EQUIPMENT FOR DETECTION OF CLADDING RUPTURES IN PEGASE REACTOR. J. Graftieaux and A. Roguin (Centre d'Etudes Nucleaires, Saclay, France). Onde Elec., 44: 752-7(July-Aug. 1964). (In French)

Pegase is a 30 Mw tank-type swimming pool reactor. Eight completely automated loops for testing fuels for gas-cooled reactors are arranged around the core. Two installations for the detection of cladding ruptures are provided. The first, the reactor monitor, is designed to detect and localize a failure in the core fuel. The second, the loop monitor, is more sensitive and is designed to detect and to follow any anomaly in the test fuel elements. The design, operation, and performance of each of these installations are described. (J.S.R.)

44946 NUMERICAL TECHNIQUES IN THE NUCLEAR CONTROL OF ATOMIC REACTORS. J. Furet, B. Jacquemin, and J. Kaiser (Centre d'Etudes Nucleaires, Saclay, France). Onde Elec., 44: 758-63(July-Aug. 1964). (In French)

The application of digital techniques appear to be suited to nuclear detectors. The application of these techniques in the measurement of neutron power and in the calculation of the period of evolution of the power is analyzed. Some devices studied using different techniques (semiconductors, transistors, magnetic components, and integrated circuits) are described and compared. The advantages in the utilization of digital techniques in safety devices and test assemblies are summarized. (tr-auth)

44947 EQUIPMENT FOR CONCENTRATION OF NUMERICAL DATA FOR EXPERIMENTATION ON NUCLEAR REACTORS. P. Jouy and P. Vergez (Centre d'Etudes Nucleaires, Saclay, France). Onde Elec., 44: 781-7(July-Aug. 1964). (In French)

The development of digital techniques led to the generalization of their use in different functions of experimental measurement sequences. New problems were posed by this choice, particularly in the definition of transducers. As the volume of electronic equipment is important, it was necessary, before starting an experiment, to be assured of the correct functioning of the installation. The flexibility of use of circuits connected with digital techniques made this possible in a simple fashion. (tr-auth)

44948 ATOMIC REACTOR SIMULATORS. M. Chaigne (Centre d'Etudes Nucleaires, Cadarache, France), R. Abdon, and J. Ladet. Onde Elec., 44: 794-804(July-Aug. 1964). (In French)

Reactor simulators are used to study procedures and to train reactor control operators. Two reactor simulators were put in service at Cadarache during the first half of 1964. They use an analog computer that can be connected to either one of the control rooms or work alone. Some details on the analog simulation of Rapsodie were given as examples. (tr-auth)

44949 USE OF MOBILE DETECTORS FOR THE CONTROL OF ATOMIC REACTORS. P. Jover (Centre d'Etudes Nucleaires, Saclay, France). Onde Elec., 44: 825-8(July-Aug. 1964). (In French)

General principles in the use of mobile detectors for reactor control (servocontrolled detector kept in constant neutron flux, and detector moved according to a preset program with automatic control of control rods in order to keep it in a constant neutron flux) were reviewed. Some examples of installations in service or under construction were described. The general characteristics of these systems were examined from the viewpoint of the minimization of the number of detectors and the viewpoint of the improvement of detectors and the viewpoint of the improvement of the safety during different operating regimes of the reactor. (tr-auth)

44950 HELIUM PERMEABILITY IN O RINGS—A PROBLEM IN NUCLEAR REACTOR DESIGN. K. Bula. Sulzer Tech. Rev. (Switz.), 46: 23-4(1964).

Permeability measurements show that there are limits to the use of O rings for critical sealing duties. The general test results and specific measured results are given in the form of graphs and tables. (auth)

44951 COOLING DEVICE FOR T.V. CAMERAS ADAPTED TO BE PLACED IN THE INTERIOR OF NUCLEAR REACTORS. (to Pye Ltd.). French Patent 1,287,168. Jan. 29, 1962. Priority date Apr. 29, 1960, Great Britain.

A cylindrical TV camera adapted to be lowered into cooling channels of a nuclear reactor was provided with a device for cooling the camera by the Peltier effect. P-type semiconductor rings were placed on the camera alternately with n-type semiconductor rings. Two adjacent rings of different types were alternately connected at their bases and their tops so that they formed an electrical series connection. Into this circuit a current was fed so that by the Peltier effect the base connections were cooled while the top connections were heated. In order to control the temperature of the top connections a double-walled sleeve covered the whole. The annular space between the walls was filled with a material in fusion, the fusion heat of it ensuring during the fusion period a defined temperature. The camera may also be surrounded by two thermally conducting shells thermally connected by p-type and n-type semiconductors, while the remaining interstice between the shells is filled with thermal insulating material. (IIB)

44952 MODERATOR BAR FOR NUCLEAR REACTORS AND NUCLEAR REACTOR IN WHICH IT IS USED. (to Commissariat a l'Energie Atomique). French Patent 1,312,623. Nov. 12, 1962. Filed Nov. 10, 1961.

In a reactor the solid moderator is often constituted by a pile of graphite bars, some of them forming columns provided with an axial channel for receiving fuel elements generally provided with cooling fins, so that an essential annular space remains for the passage of the coolant. In order to increase heat exchange without increased coolant blower power, the cylindrical walls of the channels were provided with grooves reaching in continuously from end to end of each channel. In the case of longitudinal cooling fins the channels were heliocoidal, while with transversal fins straight grooves were used. (IIB)

44953 IMPROVEMENTS IN SAFETY DEVICES FOR PREVENTING THE BLOW-OUT OF FUEL ELEMENTS DURING THEIR DISCHARGE FROM A REACTOR CHANNEL. (to Electricite de France (Service Nationale)). French Patent 1,313,262. Nov. 19, 1962. Filed Nov. 15, 1961.

In nuclear reactors having vertical channels adapted to be recharged during reactor operation the blow-out effect may arise, if part of the fuel elements of the channel are already removed. In order to prevent this, an extra pressure loss is created when the end piece disposed in the upper extremity of the channel is removed in order to get access to the fuel elements, so as to give an annular opening in the reactor channel through which supplementary coolant flow enters the channel from a horizontal slit communicating with the high-pressure side of the reactor core. (IIB)

44954 FLUID TIGHT BALANCED COUPLING DEVICE. (to Electricité de France). French Patent 1,315,059. Dec. 10, 1962. Filed Nov. 2, 1961.

A device for fluid-tight coupling a reactor charging machine to an access hole in the reactor pressure vessel has to satisfy a series of conditions, e.g., to ensure the compensation of important changes in distance between the machine and the vessel due to thermal expansions or centering deviations. The device consists of two sleeves interconnected by a bellow and disposed above each other, the lowest being fixed to the top of the access hole nozzle, while the upper one is supported by an annular piece adapted to be pushed upwards by a series of hydraulic jacks in order to be directed against the flange of the lower opening of the charging machine. A second series of such jacks controls the displacement of a second annular flange onto which are jointed a series of hooks adapted to cooperate with the flange of the charging machine and to press it against the upper sleeve of the charging machine. (IIB)

44955 TELESCOPIC CONTROL RODS FOR NUCLEAR REACTORS. (to Compagnie Générale d'Électricité). French Patent 1,322,339. Feb. 18, 1963. Filed Feb. 16, 1962.

A reactor control element was designed that has a variable axial dimension, which is longer at its working position than at its withdrawn position. It has a suspension cable passing axially through that portion of the element, the length of which has to be changed and fixed to the lower extremity of this portion. The element itself may be constituted by a series of telescopic elements sliding one into another, by a series of helicoidal springs, or by an extendible bellow. The element may also be constituted by a vertical channel enclosing a fluid mass supported by a piston sliding in this channel and suspended by the cable. For reducing the active length of the element the piston is hoisted up, so that the fluid mass is pushed into a large chamber disposed at the upper extremity of the channel. (IIB)

44956 DEVICE FOR DETECTING BURSTS. (to United Kingdom Atomic Energy Authority). French Patent 1,322,730. Feb. 18, 1963. Priority date May 25, 1961, Great Britain.

For detection of bursts of pressure vessels, e.g., for vessels of nuclear reactors cooled by pressurized carbon dioxide, a device with two chambers was designed. The first chamber is directly in communication with the vessel space, while the other one is connected with it by throttle means. Bursting of the vessel causes a sudden lowering of the pressure in the first chamber, while pressure lowering in the second chamber cannot follow so quickly, so that means responsive to the difference in pressure of the two chambers may furnish a warning signal. Three identical devices are provided to control a common warning circuit according to the "two of three" principle. (IIB)

44957 IMPROVEMENTS RELATING TO REFLECTORS FOR NUCLEAR REACTORS. (to U. S. Atomic Energy Commission). French Patent 1,323,167. Feb. 25, 1963. Priority date May 3, 1961, United States.

It recently became known that a fast neutron flux may produce a shrinkage of graphite. Therefore in a graphite reflector, a fast neutron flux may produce stresses. In order to partially compensate for this effect, a graphite reflector was developed that consists of a multiplicity of graphite bars pressed tightly together and arranged with the axis essentially perpendicularly to the surface of the reactor core; the inner end of each bar has a circular cross section and is provided with a narrowing axial hole. The bars, at their outer ends have a rectangular cross section. The region of the essentially circular cross section reaches to a region within the reflector where the fast neutron flux is lower than 10% of the fast flux at the core surface. (IIB)

44958 FLUID DRIVEN CONVEYING MECHANISM. (to Communauté Européenne de l'Énergie Atomique (EURATOM)). French Patent 1,324,285. Mar. 11, 1962. Filed Mar. 1, 1962.

A conveying mechanism was adapted to perform translation movement of a series of similar elements in one or several go and return cycles within an inaccessible space. This mechanism is used for the displacement of fuel elements or isotope containers in two parallel nuclear reactor channels forming two linear branches of an endless chain. The mechanism is constituted by a central section consisting of two channels for the displacement of the elements, by two cylindrical magazines disposed at the extremities of the channels serving for the transfer of the elements from one channel to the other, and by a driving unit provided with a hydraulic or pneumatic piston controlling a push rod. This rod is adapted to push an element from the first magazine into the first channel producing in this way a movement of all elements in the channel, so that the last element enters the second magazine and actuates there another pushing mechanism, working in a similar way and in the opposite direction for the second channel. (IIB)

44959 CONTROL RODS FOR NUCLEAR REACTORS. (to General Dynamics Corp.). French Patent 1,326,447. Apr. 1, 1963. Priority date Mar. 24, 1961, United States.

Control rods for nuclear reactors were designed with each composed of a plurality of neutron absorbing pieces each containing a certain concentration of neutron-absorbing burnable poison. The concentrations are sufficient to compensate for the reactivity losses during the operating

period of the reactor because of the steady diminution of these concentrations due to neutron absorption. The pieces may have cylindrical or annular shape and be coaxially disposed. They fit in groups one into another and each of these groups is separated from the succeeding one by spacing elements. The poison may be uniformly dispersed within a refractory filling material e.g. alumina, while the poison may be constituted by the metal or compounds of the following elements: gadolinium, cadmium, and samarium. (IIB)

44960 IMPROVEMENTS RELATING TO NUCLEAR REACTORS HAVING THE COOLANT SEPARATED FROM THE MODERATOR. (to Societe Belge pour l'Industrie Nucleair "Belgo-Nucleaire" S.A.). French Patent 1,329,608. May 6, 1963. Priority date Mar. 9, 1961, Belgium.

In order to avoid thermal stresses containers through which the moderator circulates were designed in the shape of a tube closed at one end, while the moderator inlet and outlet are provided at the other end. These inlets and outlets are joined to suitable inlet and outlet headers. Each tube may have, at its blind end, a chamber for disposing measuring instruments, etc. (IIB)

44961 GRAPHITE THERMAL COLUMN FOR NUCLEAR REACTOR. (to Société des Forges et Ateliers du Creusot). French Patent 1,330,909. May 20, 1963. Filed May 18, 1962.

A graphite thermal column was placed outside the lateral thermal shield of a nuclear reactor within a cavity in the concrete biological shielding. It consists of two graphite blocks in the form of a parallelopipedum, joined to each other in their common vertical symmetry plane passing through the reactor axis. The block near the reflector is surrounded by a thermal shield constituted by extensions of the lateral thermal shield, while the other block is surrounded by a metal sheet lining fixed to the wall of the biological shielding. The blocks are constituted by piling up equal number of beds of graphite bars crossed from bed to bed. The vertical joining faces between the bars and the horizontal joining faces between the beds in the two blocks do not coincide. Two adjacent beds of each block are interconnected by keys disposed parallel to the symmetry plane and engorging in two corresponding V-shaped grooves of the blocks of these beds. The column contains a plurality of experimental channels of square cross section, disposed parallel to the symmetry plane and adapted to be closed by graphite plugs. (IIB)

44962 CARRIAGE FOR ELECTRIC OR PNEUMATIC CONNECTIONS. (to Électricité de France). French Patent 1,331,946. June 4, 1963. Filed Mar. 7, 1962.

A carriage was adapted to ensure quick and safe connection of electric and pneumatic supply lines with a servicing or charging machine movable on a reactor charging floor. A connection casing is supported by the carriage of the machine and is jointed at the end of an arm, the other end of which is guided within V-shaped rails mounted verti cally on a carriage adapted to move along a side wall of the reactor hall. A connecting bar, jointed with its ends near the lower end of the V-shaped rails and in the middle of the arm, regulates the inclination of the arm by means of an electric motor controlling the angle between the bar and the arm. Means are provided to ensure the horizontal position of the connection casing. (IIB)

44963 TRANSFERRING MECHANISM. (to General Dynamics Corp.). French Patent 1,334,611. July 1, 1963. Priority date Aug. 2, 1961, United States.

A device for the transfer of nuclear fuel elements from and into a nuclear reactor core enclosed by a pressure vessel was designed. It consists of a system of tubular sections sliding one into the other and which can be mounted in a gas-tight manner on an access hole of the pressure vessel. Two radial arms are pivotally mounted about horizontal axis near the extremity of the lowest tubular section, while the other extremities of the arms are pivotally mounted on the body of the gripping device, ensuring in this manner its vertical position. Three electric motors are provided within the tubular system serving for lowering or hoisting the lowest section, for turning the arms in appropriate lateral positions, and for actuating the gripping device. (IIB)

44964 EXPERIMENTAL LOOP FOR NUCLEAR REACTOR. (to Groupement Atomique Alsacienne Atlantique). French Patent 1,337,403. Aug. 5, 1963. Filed July 30, 1962.

A loop was designed as a series of interconnected pressure tubes adapted to be disposed within a vertical reactor channel. Means are provided for remotely controlled disconnecting of all fluid circuits within the tubes, and for lifting the tubes after the disconnection to a given level, or for removing them completely from the reactor, to allow visual control of the fuel element to be examined within the loop. There may be electromechanical means for axial displacement or discharging of the fuel element. The electromechanical means provided for discharging the common pressure tubes from the reactor are used for the loop pressure tubes. The remotely controlled disconnecting means for the fluid entrance and exit connections are respectively disposed within two spaces placed above and under the reactor core. (IIB)

44965 ELECTRO-MAGNETIC DEVICE FOR DISPLACING OF ROD SHAPED PIECES INSIDE A TUBE PARTICULARLY OF CONTROL OR SHUT-DOWN RODS OF NUCLEAR REACTORS. (to Siemens-Schuckertwerke AG.). French Patent 1,338,857. Aug. 26, 1963. Priority date July 23, 1960, Germany.

The electromagnetic device consists of two units, each provided with lifting and hold-up coils disposed outside the tube. Inside the tube there is a sleeve on the rod adapted to be axially displaced by the lifting coil. The hold-up coil controls a special fitting coupled in the axial direction with the sleeve and consisting of several radially movable pieces. If the hold-up coil is excited these pieces provoke a compression of the sleeve for coupling it with the control rod. To lift the rod the lifting and hold-up coils are alternately excited in a certain order. For lowering the rod the two hold-up coils are alternately, and the driving ones continuously, excited while a force acts continuously in a downward direction on the rod. (IIB)

44966 IMPROVEMENTS RELATING TO CONTROL ROD DRIVES AND SIMILAR EQUIPMENT. (to Nuclear Power Group). French Patent 1,344,054. Oct. 14, 1963. Priority date Jan. 26, 1962, Great Britain.

A control rod drive was designed, which is of the type comprising a winch driven by an electric motor via a reduction gear and adapted to lift or lower the control rod. In the case of power loss the weight of the rod and the diameter of the winch drum must be sufficient to ensure the complete lowering of the rod in a few seconds. For this reason a low inertia of the system would be necessary, which requires the use of an expensive low-speed motor. In order to avoid this, the reduction gear was enclosed in a casing adapted to rotate freely, while electromagnetic means were provided, which lock, when excited, this casing

against rotation, so that a power transmission over the reduction gear is possible. When this electromagnet is cut out, the power transmission is broken and the rod is easily lowered into the reactor core. (IIB)

44967 RESILIENT MODERATOR STRUCTURE FOR NEUTRONIC REACTORS. A. P. Fraas (to U. S. Atomic Energy Commission). U. S. Patent 3,149,047. Sept. 15, 1964.

A method is described for fabricating a nuclear reactor moderator structure of stressed moderator blocks. A multiplicity of longitudinally bowed moderator blocks are cemented together, while in a straightened condition, with thermally-sensitive cement to form a stressed bundle. A number of such bundles are installed in a restraining sleeve and the resultant assembly is heated to a temperature sufficient to release the thermally-sensitive cement. (AEC)

Criticality Studies

Refer also to abstract 44705.

44968 (AAEC/E-123) BUCKLING AND INTEGRAL SPECTRUM MEASUREMENTS IN U235/BeO SUBCRITICAL ASSEMBLIES. P. Duerden, D. B. McCulloch, and E. Brittliff (Australia. Atomic Energy Commission Research Establishment, Lucas Heights, New South, Wales). July 1964. 34p.

The materials buckling of four BeO-moderated U-235/aluminum alloy fueled systems having BeO/U-235 ratios of 1465, 2930, 5860, and 8790 were measured by the exponential method. Relative fission rates of U-235, U-233, and Pu-239 were also measured in the equilibrium spectrum region of the same assemblies. The experiments are described in detail, and the results compared with the predictions of a simple spectrum model (Westcott) pending analysis using more complex calculational models. (auth)

44969 (CEA-R-2478) MESURES GLOBALES DE RESEAUX A GRAPHITE DANS L'EMPILEMENT CRITIQUE MARIUS. (Integral Measurements of Lattice Properties in the Natural Uranium–Graphite Critical Facility MARIUS). Francois Cogne (France, Commissariat â l'Énergie Atomique. Centre d'Etudes Nucléaires, Saclay). Aug. 1964. 40p.

A systematic study of natural uranium-graphite lattices was undertaken in the critical facility MARIUS, which was built in 1959 in Marcoule. Integral measurement of lattice properties is carried out by the progressive replacement method. The report describes the experimental methods, the analysis of the experiments, and the results obtained for lattices with pitches ranging from 192 to 317 mm and fuel elements with cross sections ranging from 6 to 20 cm^2. The principles of correlation of the results are also outlined. Additional experimental results are also given, pertaining to the determination of the anisotropy, of both the axial and the radial migration areas, and of the age in graphite. (auth))

44970 (IDO-17000) REACTOR POWER EXCURSION TESTS IN THE SPERT IV FACILITY. J. G. Crocker and L. A. Stephan (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). Aug. 1964. Contract AT(10-1)-205. 94p.

A program of self-limiting reactor power excursion tests was performed in the Spert IV facility with a highly enriched, plate-type, water-moderated core. The tests were initiated by the stepwise addition of excess reactivity with the system at ambient temperature and atmospheric pressure. Three series of tests were performed: (a) A fiducial series of tests was performed with an 18-foot hydrostatic head above the core with no forced coolant flow in the range of asymptotic periods from approximately 1 sec to 7 msec. No damage, other than minor fuel plate bowing, was observed due to any test in this series; however, extrapolation of measured fuel plate surface temperatures indicated that fuel plate melting could be expected for excursions with periods shorter than 6 msec. (b) A brief series of tests was performed in the short-period region ($\tau < 20$ msec) with no forced coolant flow in which the hydrostatic head was reduced to two feet in order to determine the effect of changes in that variable on reactor power excursions. The only observed change in the response of the reactor for the lower-head tests was a slight reduction in measured fuel plate surface temperatures. (c) A series of tests was performed with an 18-foot head and various forced coolant rates up to 12 ft/sec through the core with reactor periods in the range from approximately 500 to 10 msec. Results from these tests showed that the addition of forced flow causes higher peak powers and broader power bursts for equal reactivity insertions than were obtained during tests without flow. The effects were most pronounced in the long-period region and decreased as the period was shortened. Also, the addition of forced flow resulted in the attainment of higher equilibrium powers which, for most tests, were approached in an oscillatory manner. The report presents a summary of the results and the conclusions which were derived from these series of tests. (auth)

44971 (KAPL-M-6186) KARE INPUT. J. L. Fletcher (Knolls Atomic Power Lab., Schenectady, N. Y.). Aug. 1964. Contract W-31-109-eng-52. 131p.

In order to perform the present capabilities of the KARE system more efficiently, and to enable new capabilities to be added to the system, the controls section (the input processing section) of KARE was rewritten. Although the same information is required, the input format is somewhat different. A current description of the new input format and of all other KARE input is given. (auth)

44972 (MIT-2344-1) STUDIES OF REACTIVITY AND RELATED PARAMETERS IN SLIGHTLY ENRICHED URANIUM, HEAVY WATER LATTICES. B. K. Malaviya, I. Kaplan, D. D. Lanning, A. E. Profio, and T. J. Thompson (Massachusetts Inst. of Tech., Cambridge). May 25, 1964. Contract AT(30-1)-2344. 311p. (MITNE-49)

The kinetic behavior of a neutron transport medium irradiated by a burst of fast neutrons was investigated on the basis of several theoretical models. Expressions were derived for the prompt-neutron decay constant of the asymptotic thermal flux in a subcritical multiplying system. These expressions relate the decay constant of a subcritical assembly to various parameters of interest. Pulsed neutron experiments were made with subcritical assemblies to measure lattice parameters. The pulsed neutron method was also applied to the measurement of absolute reactivity and the reactivity worth of control rods in far subcritical assemblies. Concurrently with the pulsed neutron studies, steady-state exponential experiments with control rods were also undertaken. Die-away experiments on pure moderator assemblies were made to measure the thermal-neutron diffusion parameters of heavy water at room temperature and the effect of thermally black rods inserted axially in a cylindrical moderator assembly. Pulsed neutron runs on unperturbed lattices were used to evaluate such lattice parameters as k_∞, L^2, k, f_m, B_m^2, etc. These values are in agreement, within experimental uncertainties, with the results of

steady-state exponential experiments and of calculations based on the THERMOS code. Pulsed neutron experiments on pertubed lattices were made to find prompt-neutron lifetime and the absolute negative reactivity of the assembly. The worths of control rods were also measured. The pulsed neutron and steady-state experiments for the measurement of the reactivity effect of control rods give results that agree within the experimental uncertainties. Two-group theory, with no allowance for absorption in the fast group, is found to underestimate the worth of the rod by a few per cent. The conditions for the validity of control rod experiments in exponential assemblies were considered. Suggestions for extending the techniques developed in this work and for refining the results are also included. (auth)

44973 (PAN-102/IX) IZMERENIE REZONANSNYKH INTEGRALOV (OBZOR PROBLEM I SOSTOYANIE RABOT). (Resonance Integral Measurements—A Review of the Present Status and of Some Problems). Yatsek Bouzhyk and Vitol'd Suval'ski (Polish Academy of Sciences. Inst. of Nuclear Research, Swierk). Mar. 1963. 17p.

The current status of the knowledge of resonance integrals of the elements, as well as the problem of empirical formulas for effective resonance integrals of the reactor fuel are discussed. Particular attention was paid to those elements for which no actual data are available, or for which the results published by various workers are inconsistent. Some aspects of the measurement methods used are discussed. The presented material will contribute information for the preparation of the experimental program. (auth)

44974 (TID-21190) INVESTIGATIONS IN SPATIAL REACTOR KINETICS. P. T. Hansson and L. R. Foulke (Norway. Institutt for Atomenergi, Kjeller). Sept. 1962. 55p. (KIR-N-14)

Measurements of the spatial dependence of the zero-power transfer function of NORA were performed by the conventional frequency-response technique. Significant spatial effects were found for frequencies higher than the break frequency β/ℓ, and the wave-nature of the flux space-time variation was recognized. A theoretical interpretation based on two-group diffusion theory is given by solution of the equations in the finite difference approximation on an analog computer. In general, there is good agreement between theory and experiment. (auth)

44975 AN EXPERIMENTAL STUDY OF THE INTERACTIONS BETWEEN CONTROL RODS IN A SUBCRITICAL ASSEMBLY. M. A. Ghafoor and P. J. Grant (Imperial Coll. of Science and Tech., London). Brit. J. Appl. Phys., 15: 1179-85(Oct. 1964).

Measurements were made of the reactivity controlled by 1, 2, or 4 control rods, of mild steel, cadmium, or boron carbide at various positions in a natural uranium and graphite exponential assembly. Comparison is made with predictions based on: thermal neutron absorption and no fast neutron absorption; thermal neutron absorption together with fast neutron absorption represented by an extrapolation length averaged over a 1/E spectrum; thermal neutron absorption together with fast neutron absorption in which the extrapolation length is averaged by means of age theory. The third method gives good agreement with experiment in media having few voids; theory does not satisfactorily account for the effects of large voids. (auth)

44976 NEW SIGNS OF THE SINGULARITY OF THE SOLUTION OF THE FIRST BOUNDARY-VALUE PROBLEM FOR AN EQUATION OF THE ELLIPTICAL TYPE AND A SYSTEM OF THE EQUATIONS OF AN ATOMIC REACTOR. V. I. Skorobogatko and O. I. Bobik (Inst. of Mathematics, Academy of Sciences, Ukrainian SSR). Dopovidi Akad. Nauk Ukr. RSR, No. 6, 703-6(1964). (In Russian)

Criteria of solvability of the first boundary-value problem are indicated for an equation of the elliptical type. There is a corollary: the results may be used in designing vessels of arbitary shape for safe storage of radioactive substances. (auth)

44977 RESONANCE ABSORPTION OF NEUTRONS IN HETEROGENEOUS REACTORS. S. Depken (Kungliga Tekniska Hogskolan, Stockholm). Energia Nucl. (Milan), 11: 405-14(Aug. 1964).

The resonance absorption in a volume containing absorbing and non-absorbing media heterogeneously distributed is shown to depend on the ratio G(E) of averaged collision densities. The formula obtained is the natural generalization of the formula valid for the homogeneous reactor. An approach to the resonance escape probability p is derived. As it does not deviate much from experimental p, it is well suited to constitute the basis of an empirical formula for p. This will be free from averaged cross sections and will be very little depending on empirical parameters. Another result of the theory is a theorem that can be of use in calculations of p for reactors with fuel clusters in the cell. (auth)

44978 THE IMPORTANCE EXPERIMENT FOR THERMAL NEUTRON ABSORBERS IN THE CORE OF JRR-2. Yasushi Nakai (Mitsubishi Atomic Power Industries, Inc., Omiya, Saitama Prefecture, Japan), Kinichi Haginoya, Mitsuo Yokota, Yasuhiko Miyasaka, Isao Arase, Shizuo Kikkawa, Denjiro Nemoto, and Osamu Sugimoto. Nippon Genshiryoku Gakkaishi, 6: 517-22(Sept. 1964). (In Japanese)

Measurements were made on thermal neutron absorbers such as iron, aluminum, cadmium, natural uranium, and mass light water in the central experimental hole (VT-1) of JRR-2, checking the reactivity change for their insertion especially about the effect of their volumes and locations. Reactivity effect between mass heavy water and light water was compared by the experiment in VT-1 and the vertical experimental hole No. 9 (VT-9) that is set in the heavy water reflector at the radius of 27⅝ in. The radial and vertical thermal neutron flux inside and in the neighborhood of mass light water inserted in VT-1 was measured and compared for that of mass heavy water and mass void. The maximum value of reduced reactivity was about 0.55% for 100 cc iron, 0.1% for 100 cc aluminum, 0.08% for 20 cc natural uranium, and 1.0% for 800 cc mass light water, respectively at the center of the core and the reactivity effects for their inserted locations are proportional to the square of thermal neutron flux. The mass light water importance is not constant along the radius in the core, i.e., a negative effect was observed near the center and positive effect in the reflector contrarily. The peaking of thermal neutron flux is given in the mass light water comparing in the mass void or heavy water. The peaking value is about 2. (auth)

44979 THE STATUS AND THE FUTURE OF THE MONTE CARLO METHODS. Akira Tsuruo (Japan Atomic Energy Research Inst., Tokyo). Nippon Genshiryoku Gakkaishi, 6: 523-7(Sept. 1964). (In Japanese)

Discussion is presented on evaluation of the Monte Carlo methods for reactor calculations, statistical and analytical techniques of the Monte Carlo methods, Monte Carlo calculations, and the future of the Monte Carlo methods. (P.C.H.)

44980 REACTOR PHYSICS AND PERFORMANCE. Jack Chernick, R. Avery, and T. A. Auerbach. Nucl. News, 7: No. 10, 20-3(Oct. 1964).

A summary is given of the Geneva Conference papers on theoretical methods, thermalization theory and experiment, lattice studies, and critical and subcritical experiments on reactor physics and performance. (C.E.S.)

44981 REACTOR KINETICS, CONTROL AND SHIELDING. Jack Chernick, Everitt P. Blizard, and A. Radkowsky. Nucl. News, 7: No. 10, 26-8(Oct. 1964).

A summary is given of the Geneva Conference papers on reactor kinetics, control, and shielding. (C.E.S.)

44982 XENON INSTABILITIES. J. V. Wilson. Nucl. Safety, 5: 345-54(1964).

It is noted that the instability may be of the fundamental type in which the power throughout the reactor rises and falls if uncontrolled or the spatial type in which the power variations are dependent on position in the reactor. Discussions are included on xenon instability modes, computer studies and control of xenon oscillations. (J.R.D.)

44983 MATERIAL BUCKLING AND CRITICAL MASSES OF URANIUM RODS CONTAINING 3 WT% U^{235} IN H_2O. W. B. Rogers, Jr. and F. E. Kinard (E. I. du Pont de Nemours & Co., Aiken, S. C.). Nucl. Sci. Eng., 20: 266-71 (Nov. 1964). (TID-19880)

Exponential experiments with light-water moderator were conducted to determine criticality standards for the handling of uranium metal enriched to 3 wt % in ^{235}U. These measurements, made with massive rods 2 and 3 in. in diameter, were combined with Hanford measurements with smaller rods to provide critical bucklings and masses for H_2O-moderated lattices over a range of rod diameters from less than 0.15 to more than 3 in. Subcritical buckling measurements are compared with the more conventional approach-to-critical method. (auth)

44984 FAST-SPECTRUM DOPPLER MEASUREMENTS. PART II. A MEASUREMENT OF A NEGATIVE DOPPLER EFFECT IN U^{235} AND NEW MEASUREMENTS IN Th^{232} AND U^{238}. T. H. Springer, S. G. Carpenter, and R. J. Tuttle (Atomics International, Canoga Park, Calif.). Nucl. Sci. Eng., 20: 272-80(Nov. 1964).

A negative Doppler effect was observed in measurements on a metallic uranium sample (enriched to 93% in ^{235}U) placed in a typical fast-reactor spectrum which has a median fission energy of 195 kev. The plausibility of the negative sign is supported on theoretical grounds, although with the use of standard analytical techniques and the limited number of resonance parameters at present available, it can not be calculated for this spectrum. The value for $|1/\rho|(d\rho/dt)$ was found to be -5.65×10^{-6}/°C. Measurements were made on ^{238}U and the data on ^{232}Th, previously published, were extended to 930°C. The agreement between analytical and experimental values for the latter materials is good. (auth)

44985 A NEW INTEGRATION METHOD FOR MEASUREMENT OF THE REACTIVITY OF A NUCLEAR REACTOR IN THE SUB-CRITICAL REGION. L. Beliard and J. Weill (Centre d'Etudes Nucleaires, Saclay, France). Onde Elec., 44: 764-73(July-Aug. 1964). (In French)

A method for the measurement of the reactivity modulation is used to introduce perturbations in the reactor. The perturbations produced are then detected and integrated so that the quantities difficult to measure can be ignored. The value of α is thus obtained, from which the reactivity ρ can be easily deduced. Experiments were made on the Ulysse Reactor. The principal advantage of this method is its simplicity. (tr-auth)

44986 MEASUREMENT OF TRANSIENT REGIONS WITH GREAT DYNAMICS IN NUCLEAR REACTORS USING NUMERICAL TECHNIQUES. M. Rogerieux and P. Vergez (Centre d'Etudes Nucleaires, Saclay, France). Onde Elec., 44: 788-93(July-Aug. 1964). (In French)

The rapid transience of measurements necessitates the use of several staged detectors. Digital techniques, already required for the output of the results and the switching of detectors, were generalized to the principle of measurement. An automatic test assembly was added to the measurement system. The assembly can be controlled both locally and remotely, according to the experimental program. (tr-auth)

44987 REACTOR DYNAMICS PROBLEMS TREATED BY ANALOG CALCULATIONS. C. Caillet (Centre d'Etudes Nucleaires, Saclay, France). Onde Elec., 44: 805-11(July-Aug. 1964). (In French)

After a description of the equipment of the analog calculation centers of the CEA, the nature of the different problems resolved in the region of reactor dynamics is reported. There are two classes, one relative to the study of simple elements (core, exchanger, rotating group) and the other relative to the study of systems of simple controlled or uncontrolled elements (nuclear power plant or motor). Some examples are given in each case. (tr-auth)

44988 RAPID STARTUP OF ATOMIC REACTORS. J. Furet and J. Weill (Centre d'Etudes Nucleaires, Saclay, France). Onde Elec., 44: 812-15(July-Aug. 1964). (In French)

Two methods of fast startup that can be made completely automatic are described. They are essentially connected to the measurement of the evolution of the fission rate as a function of time, either for a constant and high reactivity increase, or for a reactivity increase by steps (at a constant and high rate). Some automatic fast startup programs are deduced and analyzed. (tr-auth)

44989 APPLICATION OF THE METHOD OF MEASUREMENT OF LOW REACTIVITIES TO RAPID STARTUP OF NUCLEAR REACTORS. J. Valat (Centre d'Etudes Nucleaires, Saclay, France). Onde Elec., 44: 816-24(July-Aug. 1964). (In French)

A fast startup method for reactors is proposed based on the fast absolute measurement of the antireactivity, followed by a very fast withdrawal of the control rods, monitored by relative measurements of the reactivities during brief steps. The fast absolute measurement of the antireactivity is obtained essentially by random excitation and intercorrelation. The random source excitation is studied first with classical "external" delay intercorrelation and then with "internal" delay intercorrelation. The latter appears much more efficient if spatial effects are neglected. In this case, it would even be possible to deal with light water reactors, if not with heavy water reactors. But for these two types of reactors, a random reactivity excitation (always with internal delay intercorrelation) seems preferable. (tr-auth)

Design and Feasibility

44990 IMPROVEMENT IN NUCLEAR POWER PLANTS. (to Foster Wheeler Ltd.). French Patent 1,323,262. Feb. 25, 1963. Priority date May 15, 1961, Great Britain.

In order to suppress thermal stress in ducts between the reactor pressure vessel and a single cylindrical boiler casing the vessel and the casing were only fixed to their supporting floor at one point. Two fixation points were arranged very close to each other so that they practically coincided, while two independent circuits were provided between the vessel and the casing. Each of these circuits

consisted of a heat-exchange element within the heat-exchanger casing, which may be formed by two adjacent headers disposed at the bottom of the casing and interconnected by a series of U-shaped tubes reaching upward into the casing space. (IIB)

44991 PROCESS FOR COOLING CONCRETE CONTAINERS ENCLOSING A HEAT SOURCE. (to Nuclear Power Plant Co. Ltd. and A.E.I. John Thompson Nuclear Energy Co. Ltd.). French Patent 1,323,737. Mar. 4, 1963. Priority date Mar. 3, 1961, Great Britain.

A concrete container was constructed of a layer of heat-conducting material disposed between the heat source and the concrete and cooled by a fluid passing through adjacent cooling channels. A thermally insulating layer may be disposed between the heat-conducting layer and the heat source. In case the container constitutes the pressure vessel of a nuclear reactor, the thermally insulating layer is formed by a neutron-absorbing material. The two layers cover the inner surface of the vessel including the walls of the access holes, while the cooling channels are formed by tubes disposed onto the heat-conducting layer and are connected in two independent cooling circuits. (IIB)

44992 LIQUID MODERATED NUCLEAR REACTOR. (to United Kingdom Atomic Energy Authority). French Patent 1,326,890. Apr. 1, 1963. Priority date June 28, 1961, Great Britain.

Nuclear reactors are known in which the core is immersed in a moderating liquid, and an emergency shutdown is performed by a quick lowering of the liquid level. A design is described in which a casing open at its bottom is placed under the reactor core within the moderator and encloses a given amount of pressurized gas over a free surface of this moderator near the bottom of the casing. This gas space communicates with a vertical duct whose upper extremity is extended over the moderator level by two lateral downward-directed branches closed at their outlets by electrovalves, while another branch of the duct is connected with a source of pressurized gas. The lower extremity of a second vertical duct dips into the free surface of the moderator within the casing. This duct has some small lateral openings in the proximity of the free surface through which gas passes from the gas space into the duct and further through a flowmeter at the upper extremity of it extending over the moderator level. (IIB)

44993 IMPROVEMENTS RELATING TO NUCLEAR REACTORS. (to Babcock and Wilcox Ltd.). French Patent 1,335,719. July 15, 1963. Priority date Aug. 15, 1961, Great Britain.

A pressurized-water reactor was designed with natural uranium disposed heterogeneously over the core with a water to fuel ratio essentially lower than that adopted for a core moderated with heavy water and essentially higher than the ratio corresponding to a light-water-moderated core, this ratio being between 5 and 15. The moderator is a mixture of heavy and light water, the mixing ratio of which is changed during the reactor operation so that the reactivity change due to fuel burnup is partially compensated. At the beginning 5% light and 95% heavy water are used. During common reactor operation the reactivity may decrease a little at the beginning, afterwards, it may rise before it begins to decrease steadily, so that for compensating for fuel burnup the light water percentage is at first lowered, then increased, and finally lowered to zero. (IIB)

44994 NUCLEAR REACTOR. (to North American Aviation, Inc.). French Patent 1,336,383. July 22, 1963. Priority date Aug. 1, 1961, United States.

A nuclear reactor with a coolant passing in downward flow from an inlet chamber through the reactor core to an outlet chamber, was provided with fuel assemblies forming coolant channels supported by a plurality of elements forming the supporting grid. Each element was provided with a vertical duct passing through the outlet chamber, having lateral openings for the passage of the reactor coolant and transferring the weight of the fuel elements to the bottom of the outlet chamber. Each duct was extended at its upper extremity by a support plate having fittings for receiving the end sockets of at least one fuel element. Each fuel assembly was provided with a central control rod channel, the movements of the control rods being effected from the reactor bottom with the aid of driving rods passing through the vertical ducts. (IIB)

44995 IMPROVED REACTOR WITH CIRCULATING FUEL. (to U. S. Atomic Energy Commission). French Patent 1,338,868. Aug. 26, 1963. Priority date May 17, 1961, United States.

A nuclear reactor was designed with cylindrical channels for the passage of fluid fuel. In order to improve the heat transfer characteristics, the inlet of each channel is provided with means for creating a tangential fluid velocity component such as to modify the profile of the axial velocity of the fuel. The means may be an element having a series of radially disposed blades, the downstream sides of which have varying tangential angles so that the produced tangential component of the fluid velocity is higher in the center than in the marginal regions of the channels. Means are provided at channel exits for producing at each radial point of the channel a pressure loss proportional to the square of the axial velocity at this point. These means may be constituted by an outlet element having blades similar to that of the inlet element but having inlet angles similar to the angles of the downstream side of the inlet element. The outlet element may also consist of a perforated plate, in which the diameter and the distribution of the perforations vary with the distance from the center. (IIB)

44996 PROCESS FOR VAPOR GENERATION IN NUCLEAR REACTORS AND DEVICE FOR WORKING WITH THIS PROCESS. (to Allmanna Svenska Elektriska Aktie-Bolaget). French Patent 1,341,433. Sept. 16, 1963. Priority date Dec. 28, 1961, Sweden.

A process for vapor generation was developed for a nuclear reactor having hollow vertical fuel elements, where the liquid reactor coolant circulates in a rising flow over the outer surface of these elements in order to be brought up to about the boiling temperature. After this, the coolant passes successively through a region provided with oblique blades for producing gyratory movement and a funnel extension in order to form a free surface. The lowering of pressure due to the acceleration promotes evaporation. The remaining liquid flows over the edge of the funnel, while the vapor is collected at the center from where it flows downwards in order to be superheated inside the fuel elements. (IIB)

44997 CORE OF A HOMOGENEOUS REACTOR. (to U. S. Atomic Energy Commission). French Patent 1,344,634. Oct. 21, 1963. Priority date Dec. 13, 1961, United States.

A process was developed for removal of heat and fission products from a nuclear reactor using fused plutonium as fuel. It consists in mixing liquid sodium with the plutonium, so that heat and fission products are transferred to the sodium, in separating the sodium from the plutonium, leading it to a heat exchanger, and recycling it with the aid of a pump. The liquid fuel may be circulated through the core

with the aid of a sodium jet. Closed circuits of the sodium and the fuel may be in contact along a portion of the fuel's path. In the latter case the reactor tank has, in its upper portion, the sodium circuit consisting of the sodium pump mounted at the top, a central duct for leading the sodium downwards to a plate adapted to reverse the sodium flow for passing it successively through a mixing zone with the plutonium, a separating zone, the heat exchangers, and a sodium trank from which the sodium is recycled to the pump. (IIB)

44998 HIGH FLUID FLOW RATE NUCLEAR REACTOR. Robert H. Fox (to U. S. Atomic Energy Commission). U. S. Patent 3,150,054. Sept. 22, 1964.

Nuclear reactors requiring high gaseous or liquid flow rates through a solid reactor core are discussed. The reactor core is provided with fluid-flow channels, which radially converge from the core periphery to a central cylindrical void. A fuel gas is directed radially through the channels wherein it is heated and expanded by the transfer of heat from the reactor core. During passage of the gas thrcugh the channels, pressure-drop and frictional-drag forces are created, which, as a result of the radial convergence of the channels, are directed inwardly and hence are primarily compressive forces. These compressive forces support the core and greatly reduce the requirements for heavy containment and support members needed previously to support reactor cores characterized by high liquid flow rates therethrough. (AEC)

44999 CORE ASSEMBLY FOR A NUCLEAR REACTOR. Frank Schwoerer (to U. S. Atomic Energy Commission). U. S. Patent 3,151,029. Sept. 29, 1964.

An assembly was developed for a nuclear reactor that consists of a circular cylindrical core containing fissionable material and three chevron-shaped segments containing fertile material symmetrically placed around the core. The width of each segment is less than the diameter of the core and the thickness of each segment is not greater than the radius of the core. (AEC)

45000 CONSOLIDATED NUCLEAR STEAM GENERATOR ARRANGEMENT. R. M. Douglass, R. W. Earle, H. Honig, and D. C. North, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,151,034. Sept. 29, 1964.

A nuclear reactor incorporating steam generation equipment within the reactor vessel is described. The reactor utilizes pressurized light water, which circulates within a closed cycle transferring the heat of fission from the core to the steam generator. Pumps provide for positive circulation and additional provision is made for maintaining proper primary coolant and steam pressures. A further feature is the use of lead to provide thermal and gamma shielding. (AEC)

Fuels

Refer also to abstracts 43464, 43762, 44079, and 44120.

45001 (CEND-2863-217) THE DEVELOPMENT AND TESTING OF UO_2 FUEL SYSTEMS FOR WATER REACTOR APPLICATIONS. Progress Report, April 1–July 31, 1964. W. P. Chernock, C. E. Burdg, E. I. Veil, G. Zuromsky, and J. J. Koziol (Combusion Engineering, Inc. Nuclear Div., Windsor, Conn.). Aug. 1964. Work Performed under United States–Euratom Joint Research and Development Program. Contract AT(30-1)-2863. 45p. (EURAEC-1191)

The thermal conductivity of UO_2 at temperatures up to 2400°C is reported together with an analysis of the temperature for onset of different microstructural constituents. Collapse testing of 3.175-cm-dia. tubing with t/R_0 values of 0.046 to 0.119 was completed. An analysis of collapse criteria indicates that use of the Tangent Modulus approach provides conservative estimates within 20% of actual collapse pressures within the range of dia. and tube wall thickness tested. Further refinements in the projection welding process demonstrated dimensional control of tube-to-tube spacings within specified requirements. Tube-to-spacer wire welds are of acceptable metallurgical quality. (auth)

45002 (LA-3163-MS) PLUTONIUM REACTOR FUEL DEVELOPMENT. Quarterly Status Report for Period Ending August 20, 1964. (Los Alamos Scientific Lab., N. Mex.). Sept. 1964. Contract W-7405-eng-36. 14p.

Evaluation of fuels in LAMPRE Core II is summarized. Information is also presented on the corrosive effects of iron–plutonium and cerium–cobalt–plutonium alloy fuels on tantalum and tantalum–tungsten–yttrium alloys. The development of bonding techniques, fuel containers, testing techniques, heat transfer loops, reactor components, reactor coolants, blanket systems, and modulars is discussed. (N.W.R.)

45003 (ORNL-3670(p.251-5)) WATER DESALINATION AND GENERAL REACTOR ECONOMIC EVALUATIONS. D. A. Douglas, Jr. (Oak Ridge National Lab., Tenn.).

The study of the problem of producing pure water from sea water at a low cost through nuclear heat was continued. A study was made of elements contributing to the cost of fuel element fabrication and of the literature to collect available information on the irradiation performance of metal fuels. Six reactor concepts were evaluated for central power stations. Five of these were based on advanced converter concepts utilizing a thorium fuel cycle. The task was to analyze the status of the development of the fuel elements for such reactors and to calculate the cost of fabricating the various fuel elements. (auth)

45004 (PAN-422/Doz.XI) EMISSIYA PRODYTOV DELENIYA IZ NEGERMETICHNOGO TEPLOV'DELYAYUSHCHEGO ELEMENTA REAKTORA. (The Release of Fission Products From a Leaky Fuel Element). Ksh'shtof Zharnovedki, Bogdan Filipyak, and Mikhal Chernevski (Polish Academy of Sciences. Inst. of Nuclear Research, Swierk). Mar. 1963. 13p.

Gaseous fission products behavior in the reactor fuel has been discussed with special attention to the probable mechanism of fission gases release from the WWR-S reactor fuel elements. The observed release of fission products from a leaky fuel element can be explained by the outlined theory. (auth)

45005 A METHOD OF CALCULATING NUCLEAR FUEL CYCLE COSTS AND CONDENSING THESE INTO TWO, A FIXED AND A VARIABLE PART. H. Schmale Rheinisch-Westfalisches Elektrizitatswerk AG, Essen), A. Persson, and P. Erkes. Brennstoff-Waerme-Kraft, 16: 448-53(Sept. 1964). (In German)

In a nuclear plant there is, besides the usual spare fuel, a fuel inventory in the reactor, corresponding on an average to some years' operation. The fuel consumption cost cannot be calculated only on the basis of energy content of the fuel, efficiency of the plant, and cost of the fuel. Because of limitations due to reactivity, thermal power density, metallurgical life time, mode of operation, etc., the cost varies by time. A calculation method is developed, which is generally applicable to nuclear power plants, and which delivers the result (fuel cost) as the sum of a fixed, capacity-dependent, part and a variable, output-dependent, part. (auth)

45006 CALORIMETRIC EVALUATION OF FISSION HEAT AND BURN-UP RATES IN THE ISPRA-1 IRRADIATION EXPERIMENTS. A. Gerosa and S. Moretti (CNEN, Rome). Energia Nucl. (Milan), 11: 415-25(Aug. 1964).

Experimental data on heat ratings and burnups concerning two irradiation experiments are given and discussed. The experiments were performed in the Ispra-1 Reactor, as a part of the AN|CNEN|NPPC Joint Irradiation Programme, which aims to cover a total of four irradiation experiments. Experimental relations between enrichment, fluxes, and heat ratings were defined, and can be used for the nuclear design of future experiments, as well as for the estimate of burnup rate. (auth)

45007 NUCLEAR FUEL IN THE FUTURE. Energy Intern., 1: No. 8, 16-17(Oct. 1964).

The nuclear fuel development programs of several countries are outlined; and estimates of fuel production, demand, and supply are discussed, indicating a considerable reduction of present reserves of uranium by 1970 with exhaustion of the West's supplies by 1980 unless preventive measures are taken. (D.C.W.)

45008 BOOSTER ROD FOR NUCLEAR REACTORS. (to Groupement Atomique Alsacienne Atlantique). French Patent 1,337,402. Aug. 5, 1963. Filed July 30, 1962.

The booster rod serves for reactor startup and for compensating reactivity losses due to xenon poisoning and fuel discharge during reactor operation and is essentially constituted by a fuel element adapted to be moved like a control rod and to be removed quickly from the reactor core. The rod, sliding in a vertical guiding tube and cooled by a descending fluid flow, is provided with a rack adapted to be driven by a pinion for lifting the rod into the reactor core and to be disengaged from that pinion allowing free fall of the rod out of the core. A dash-pot is provided to slow down the fall of the rod near the end of its path. The rod drive, disposed under the bottom of the reactor core, consists of a driving pinion driven by an electric motor and engaging with a second pinion mounted in an element pivotally mounted about the axis of the driving pinion. By rotation of this element the second pinion may be engaged to and disengaged from the driving rack of the rod. (IIB)

45009 NUCLEAR REACTOR. Lester Goldstein, Leon Joseph, Morton S. Silberstein, and Albert A. Weinstein (to U. S. Atomic Energy Commission). U. S. Patent 3,149,043. Sept. 15, 1964.

A nuclear reactor was designed with a core having, in cross section, the shape of a regular hexagon with a central hole of the same shape. The core is composed of a plurality of fuel elements arranged in a plurality of hexagonal rings around the central hole. They have, in cross section, essentially the shape of a rhombus. The fuel elements include a plurality of parallel plates with the fuel plates of most of the fuel elements located next to the boundaries of the core and parallel to it. The fissionable material of the plates increases in graduated steps from the boundaries of the core to the center of the core. (AEC)

45010 FUEL SUBASSEMBLY FOR NUCLEAR REACTOR. Harry O. Monson and Ernest Hutter (to U. S. Atomic Energy Commission). U. S. Patent 3,150,057. Sept. 22, 1964.

A fuel assembly was designed for a nuclear reactor. It consists of a hexagonal tube and a bundle of slender fuel rods disposed in triangular array in the tube, with each of the fuel rods having a single, helical spacer rib. To prevent bowing a plurality of ribs extending across the faces of the hexagonal tube at specific locations are provided. (AEC)

Power and Power-Breeder Reactors

Refer also to abstract 45141.

45011 (DLCS-3070203) PRIMARY PLANT SELF-ACTUATED RELIEF VALVE OPERATION. Test Evaluation. (Duquesne Light Co., Shippingport, Penna.). First Issue, May 1964. Contract AT(11-1)-292. 24p.

The purpose of DLCS 3070104 was to insure the reliable operation of the self-actuated reactor relief valves (06-H15-2, 3, 8, and 9) and the self-actuated pressurizer steam relief valves (06-H15-1 and 10). The purpose of DLCS 3070203 was to insure the reliable operation of the self-actuated reactor coolant loop relief valves (06-H15-4, 5, 6 and 7) and the self-actuated Purification System relief valves (07-H15-1 and 2). All relief valves operated reliably during the testing and were suitable for further service in the reactor plant. (auth)

45012 (DLCS-5000664) MONTHLY OPERATING REPORT, JUNE 1964. (Duquesne Light Co., Shippingport, Penna.). Contract AT(11-1)-292. 26p.

Core 2 modification of the reactor plant and the overall refueling operation continued. The overhaul of the main unit turbine remained in progress. Routine water sampling was limited to the canal water and the coolant charging water. Reference water specifications were maintained in both systems. Activities in the Core 1–Core 2 replacement operation consisted of refueling procedure preparation, procurement and preparations of refueling materials, pre-assembly operations, and inspection of components. (auth)

45013 (DLCS-5000764) MONTHLY OPERATING REPORT, JULY 1964. (Duquesne Light Co., Shippingport, Penna.). Contract AT(11-1)-292. 34p.

The station remained shutdown throughout July for the continuation of reactor plant modification for Core 2 operation, the overall refueling operation, and the main turbine overhaul. Routine water sampling was restricted to the Canal Water and coolant charging water systems, and water specifications were maintained in both systems throughout the month. Results of an inspection of the canal water system and the radioactive waste disposal system for resin deposits are presented. The extraction crane was centered over the refueling port of the reactor vessel in preparation for trial operation. (auth)

45014 (DLCS-5000864) MONTHLY OPERATING REPORT, AUGUST 1964. (Duquesne Light Co., Shippingport, Penna.). Contract AT(11-1)-292. 34p.

The modification of the reactor plant for Core 2 operation, the overall refueling operation, and the main turbine overhaul continued. Removal of spent resin from the RWD underground storage tanks for disposal was initiated. Water specifications were maintained in the canal water and coolant charging water systems. Routine water sampling was restricted to the two systems. The fuel extraction crane and the PWR-2 orifice adjustment tool were checked out and placed in service for removal and reinstallation of blanket fuel assembly F-8. Following training on the use of the center support welding machine and stud tensioner, both pieces of equipment were utilized. (auth)

45015 (DPST-64-416) DEVELOPMENT PROGRAM—HEAVY-WATER-MODERATED POWER REACTOR. James M. Boswell (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.). Sept. 1964. Contract AT(07-2)-1. 77p.

A development program is presented that would lead to construction of a prototype D_2O-cooled reactor with the goal of attaining criticality by mid FY-1970. A program is also presented for development of the thorium-uranium-233 fuel cycle with the aim of demonstraing breeding potential in the prototype reactor about two years after initial critical with uranium fuel. The thorium program would be concurrent with development of the prototype reactor. (auth)

45016 (EUR-1899,e) EFFECTS OF A LOWER TEMPERATURE ON THE NUCLEAR PROPERTIES OF A DRAGON TYPE POWER REACTOR. L. Massimo (European Atomic Energy Community. Joint Nuclear Research Center, Ispra, Italy). 1964. 29p.

Calculations were performed in order to assess the feasibility of running a Dragon-type power reactor at a power temperature so that CO_2 cooling could be used. Only the nuclear aspects of this problem were considered. It appears that lower temperatures are advantageous to the neutron economy of this type of reactors, but the effective gain is rather small. Some general remarks on the methods for the burnup calculations of high-temperature graphite reactors are added. (auth)

45017 (GAMD-3419) SHIELDING DATA FOR THE 10-Mw EBOR. J. R. Seibold and A. J. Goodjohn (General Atomic Div., Gneral Dynamics Corp., San Diego, Calif.). Aug. 15, 1962. Contract AT(04-3)-187. 28p.

Shielding requirements during after-shut-down shielding requirements and radiation levels during fuel handling, maintenance, and inspection; radiation damage estimation; contamination and activation of internal and external cooling systems; storage of radioactive materials; activation levels of shield plugs; and auxiliary shielding are considered. (D.E.B.)

45018 (GEAP-4350) FAST REACTOR MELTDOWN EXCURSIONS. ANALYSIS AND COMPUTER PROGRAM, FARM I. B. C. Luci, D. R. Riley, and N. F. Friedman (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). Dec. 15, 1963. Contract AT(04-3)-189. 198p.

The Fast Reactor Meltdown Excursions and Energy Releases program is divided into three component programs: the input program, FIN; the calculation program, FARM I; and the output program, FARO. The program serves as a tool for the determination of the reactor transients and energy releases during a fast-reactor meltdown excursion. The problem solution provides a continuous monitoring of the reactor transients from the original homogeneous state, through the melting and compaction states to an eventual subcritical condition. Coupled nuclear, inertial, and energy equations provide a basis for the problem solution. FIN, FARM I, and FARO are set up to communicate with one another through the use of the General Purpose Monitor (GPM), an executive routine which allows the user to execute independent programs in any desired sequence. The GPM was written for the Philco 2000 computer and is completely described in GEAP 3765. The three component programs were written in the FORTRAN language. The programs were designed in such a way that modifications, if necessary, may be easily made. Each individual program will fit within 16,000 computer memory locations, and all three are available for use on the Philco 2000 computer. A physical description of the problem, problem approximation, and the equations used to describe the problem are discussed. The numerical approximations utilized and details of the computer program are given. (auth)

45019 (GEAP-4617) DESCRIPTION OF E-SADE LOOP. C. M. Shields (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). June 1964. Contract AT(04-3)-189. 293p.

The primary purpose of the E-SADE (Expanded Superheat Advanced Demonstration Experiment) loop was to provide a significant (ninefold) increase in the fuel irradiation facility over the older SADE loop. The E-SADE loop replaced four VBWR boiling-water fuel elements so that, from a nuclear point of view, the loop is a steam-cooled, water-moderated sub-core of the VBWR. Steam is taken from inside the pressure vessel, it flows back into the core, and is superheated by the E-SADE fuel elements. The superheated steam is taken outside the pressure vessel, condensed, and returned to the VBWR system. Extensive instrumentation is used to measure the flow rate and temperature of the steam. The first fuel irradiated was the ESH-1 assembly, consisting of nine two-pass annular fuel elements. The second assembly was ESH-1.1, which had five annular elements from ESH-1, plus three single-rod elements and one three-rod assembly. The third fuel assembly, ESH-4, had nine multirod assemblies, designed and fabricated by the Nuclear Power Department of the Allis-Chalmers Manufacturing Company. Loop operation and safeguard data for the fuel assemblies are discussed. Complete technical specifications for loop construction and operation are given. (auth)

45020 (GEAP-4619) NUCLEAR SUPERHEAT PROJECT. Nineteenth Quarterly Report, February–April 1964. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). May 1964. Contract AT(04-3)-189. 126p.

The results of post-irradiation examination of elements from ESH 1.1 are reported. Metallographic examination of samples from elements H (Incoloy) and I (Inconel) have shown no unusual conditions. The cause for the high ultrasonic indications previously reported could not be detected. Element B (Type 348) also was in good condition in both the base clad material as well as spacer braze areas. Element F (Type 310VM) showed an unidentified grain boundary phase. All of the elements indicated a decrease in length from 0.090 to 0.150 in. for the annular elements, and 0.010 to 0.100 in. for the rod elements. All of the Inconel annular elements had outer clad wrinkles. Results of corrosion and thermal cycling tests on Zircaloy-2-to-stainless steel (Type 304) bonded joints were satisfactory for tubular specimens that are suitable for use as process tubes. Zircaloy-2-to-Incoloy joints are now being processed. Results of erosion tests run in steam and steam–water environments with specimens containing powder fuel indicate that powder densities of approximately 85% wash out while densities of about 91% do not. Analysis of tensile coupon results from specimens located in ESH-1.1 indicates that exposure of 4×10^{20} nvt had changed the tensile properties. The ferritic alloy Type 406 exhibited a decrease in ductility, whereas the 300 series stainless steel showed little change. Incoloy, Hastelloy-X, and Inconel had increases in room temperature tensile strength and decreases in ductility. Tensile strength at 1100°F was unchanged for these three. Additional information will be obtained from specimens that are being exposed in the GETR at 1300°F and greater than 10^{21} nvt. The results of the materials test in a superheat environment at 1050 and 1150°F indicate changes of varying magnitude in each alloy, depending on the degree of thermal stability of the microstructure. Except for Hastelloy-X, the elongation remained above 20% for exposures up to 10,000 hours. Investigation of the anamolies associated with the strain cycle tests revealed that for Incoloy and Type 304 stainless steel, there is an effect of

pre-aging and aging at 1300°F that decreases the cycles-to-failure significantly. For Incoloy there was a difference in failure mode between a 1-hr cycle and a 1-min cycle. The specimen cycled at the slower rate failed after eight cycles with extensive branch cracking. The specimen cycled at the higher rate failed after 22 cycles with a single jagged crack. Tests were conducted in the CL-4 loop using Type 304 stainless steel heater sheaths with the loop water chemistry controlled as in previous tests except for the O_2 content. The O_2 was held at 0.01 ppM instead of the normal 20 ppM. Two failures occurred in the 1000-hr test, both were in the thermal sleeves located near the ends of the heaters. Results of corrosion testing with Incoloy were analyzed to establish corrosion rates at temperature up to 1300°F. The rate for 3 yr can be calculated conservatively as 0.0016 in., with an upper 95% confidence limit of 0.0032 in. Isothermal corrosion rates were established at 1050 and 1150°F for other materials. Analytical methods were developed for use in analyzing data from the electron microprobe traces. With the electron microprobe, the composition of the corrosion layer can be determined as a function of depth. Analysis by this method should provide a better understanding of what the long term metal-to-system loss may be. Work was resumed on the investigation of heat transfer correlations at 800 to 1400 psi, and Reynolds numbers to 10^6. Effort will continue on means of improving the heat transfer coefficient. Removal of the ESADE loop is complete except for the shipment of one box containing contaminated material that requires some additional shielding. Inspection of fittings and components of the ESH-1.1 fuel bundle showed no unusual conditions. Process tube plugs were in good condition with no evidence of thread damage. The ESH-3 fuel assembly concept was changed. The assembly is being redesigned for insertion into EVESR, and will contain two elements (one Inconel annular and one Incoloy annular) from ESH-1.1, two elements (one Incoloy with ferrules and one Incoloy with spiral wire spacers) of seven-rod clusters from ESH-4, and an advanced fuel prototype with Incoloy clad, 0.45-in.-dia. rods, in a seven-rod cluster. Successful tests were completed on a mechanical joint for use with one element of ESH-3 to join the Zircaloy process tube to stainless steel. The thermal core reference measurements were completed, and preparations made for loading the fast core. Measurements performed on the thermal core included critical size, fuel worth, control system worth, $\partial\rho/\partial H$, (β/l), pulsed neutron detector position dependence, foil and wire activations using both 1/v and resonance detectors, and temperature effects. In general, the measured values were in good agreement with predicted values. Calculations were made to establish flooding effects in the fast core. Poison materials being considered for use in the flooding tests are Eu_2O_3, Hf, and B_4C. All three have high absorption cross sections in the low energy region, and low cross sections in the high energy region. Flooding the entire fast core (13% vol) results in a reactivity change of 14.4% Δk. Use of a few vol % (3% Hf, 1.5% Eu_2O_3, and 2% B_4C) of poison material is expected to reduce the change in reactivity to about 2%. There will be about 2% enrichment penalty associated with use of the poison materials. (auth)

45021 (GEAP-4647) HIGH POWER DENSITY DEVELOPMENT PROJECT. Seventeenth Quarterly Progress Report, April–June 1964. R. L. Holladay, Comp. (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.). July 1, 1964. Contract AT(04-3)-361. 82p.

The terminal post-irradiation examination of Task 1A fuel assemblies irradiated in the VBWR were initiated with the examination of assemblies 3C and 1A. Failure of a fuel rod in assembly 3C was verified by visual observation and analysis of surface deposits for fission products. Irradiation of eight Group I developmental assemblies containing Type 304 stainless steel clad fuel rods continued in the Consumers Big Rock Point Reactor. Twenty-four Incoloy-800 clad poison rods containing B_4C powder were inserted into six of the Group I assemblies after removing four irradiated fuel rods from each assembly. Irradiation of the ten Group II developmental fuel assemblies containing fuel rods with alternate cladding materials, Zircaloy-2, Incoloy-800 and Inconel-600, was begun in the Consumers reactor. A series of tests is being performed in the Trail Cable facility at the GETR to verify the dimensional stability of thin, annealed Incoloy-800 clad, low-density swaged UO_2 powder fuel rods when subjected to a 1500-psi boiling water environment. To date, three specimen failures have occurred due to the test capsule and specimen design. A statistical analysis of the HPD Type 304 stainless fuel clad fuel rod failure data from the VBWR irradiations was performed. Performance tests were conducted at Big Rock Point under varying conditions of reactor pressure, power, recirculation flow, and subcooling. Included in the series were core performance tests conducted at various power levels up to 230 Mw(t), pump trip and control rod oscillator tests, and a demonstration of reactor flow control. A computer code, PIQUE, used to calculate peak heat flux and nodal burnout ratio information at San Jose on the Philco-2000 was checked. Calculations to determine the configuration of the high power density (60 kW/l) core are continuing. Program changes for the on-line computer were made and evaluated. Tests involving the large core were completed, including the demonstration of increased core power. (auth)

45022 (GNEC-327) ADVANCED BONUS CORE DEVELOPMENT PROGRAM. Quarterly Progress Report No. 1, November 1963–January 1964. John F. Gibbons, Ray L. Lyerly, William A. Maxwell, and Stanley E. Turner (General Nuclear Engineering Corp., Dunedin, Fla.). Feb. 25, 1964. Contract AT(40-1)-3154. 178p.

Activities in a program for the design of advanced fuel, irradiation testing and evaluation of experimental fuel assemblies, and establishment of methods for fuel fabrication that will permit production manufacturing are reported. The work program for the out-of-pile testing of the Advanced BONUS Core fuel element components is described. A program schedule which defines the interrelationship and timing for the various phases of the Advanced BONUS Core Program is included. Mechanical design and arrangement studies of the various features and components of both the annular-multitube and the small solid fuel elements were made. Thermal performance of the two reference fuel element designs in the BONUS reactor was evaluated and compared with the BONUS first core. The relative performance advantages of each design were identified on a preliminary basis but final selection must await the conclusion of cost evaluation studies and experimental program results. Nuclear analysis of the small solid- and annular-multitube fuel elements was performed using a one-group two-dimensional PDQ cell calculation to estimate power distribution for heat transfer calculations and to generate local azimuthal peaking factors. In the experimental program, orders were placed for development quantities of Zircaloy tubing, Zircaloy-Inconel transition joints, superheater steam tubing, and hardware for test equipment. Preliminary data on the mechanical properties of steam tube materials were obtained from the corrosion-aging experiments.

The fuel element thermal cycling test specification was prepared. A facility for housing the single tube strain cycling experiment was constructed at GNEC and the test rig is approximately 50% completed. Welding development of the process for making the tube-to-tube-sheet welds has started. Samples of these weld joints were manually welded with moderate success. Preliminary creep test results of Inconel 625 were obtained at 1100°F which show the excellent creep resistance of this material in the temperature range of operation for the superheater tubes. The work on vibratory compaction of experimental assemblies has started. (J.R.D.)

45023 (HW-81473) D_2O EXPERIENCE AT PRCF. J. R. Fishbauger (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 24, 1964. Contract AT(45-1)-1350. 9p.

The Plutonium Recycle Critical Facility (PRCF) is located within the Plutonium Recycle Test Reactor complex at Hanford Laboratories. Pre-operational testing, startup, and initial experiments with heavy water moderator began in late 1962 and continued through October 1963. These first experiments included reactivity measurements with irradiated fuel elements, utilizing an experimental capability unique to this critical facility. In November 1963, the D_2O inventory was removed to storage and work began to provide capability for light water-moderated experiments. The report summarizes D_2O experience at PRCF from startup through 1963. Brief descriptions of the D_2O systems are included. Discussions of design considerations, operating activities, and items of emphasis offer insight into the business of using heavy water in a large system at near-ambient temperatures and pressures. (auth)

45024 (MND-2706-12) TUBULAR CORE DEVELOPMENT PROGRAM. Quarterly Progress Report No. 12, January 1—March 31, 1964. (Martin-Marietta Corp. Aerospace Div., Baltimore). Contract AT(30-1)-2706. 136p.

A study of axial zoning of the lumped burnable poison element in Core 3 was completed. Preliminary calculations of depletion, rod withdrawal, and steam void effects on Core 3 power peaking were performed. The study of fuel element surface roughness effects on Core 3 thermal-hydraulic performance was completed. The investigation of two proposed control assembly guide systems was initiated. Modifications to the PM-1/PM-3A instruction manuals were 90% complete. The preliminary design drawing of the grid and control element drive plates was completed. UO_2 powder processing studies were performed. The second and third autoclave wear tests on finger control element materials were completed; electrolyzed samples demonstrated excellent wear characteristics. Fabrication of the wear test fixture for loop testing finger control element materials was initiated. A group of full length Core 3 fuel elements was successfully fabricated with depleted UO_2. Irradiation testing of fuel specimens in the ORR PW loop continued until February 22; at that time, they were removed due to buildup of Co activity in the loop water. Corrosion of flux suppressor sleeves was responsible for the activity. A design drawing and specification for lumped poison element irradiation specimens was completed. The excursion analysis of a core containing Core 3-type fuel elements was completed. An amendment to the facility operating license was requested from AEC. Analysis of the lumped poison element experiments continued. The finger control element reactivity experiments were completed. Measurement of the neutron activation distribution through the wall of a Core 3 fuel tube was initiated. Preliminary air—water flow tests were conducted. An error analysis was performed, and a data reduction code was written. Fabrication of the first test section was completed. (auth)

45025 (NP-14267) ALGUNAS OBSERVACIONES SOBRE LOS REACTORES DE POTENCIA TIPO U NATURAL-GRAFITO-GAS. Informe No. 102. (Some Observations on Power Reactors of the Natural Uranium-Graphite-Gas Type. Report No. 102). Bela Jose Csik (Argentina. Comision Nacional de Energia Atomica, Buenos Aires). 1964. 68p.

British-designed nuclear power plants of the gas-cooled type are analyzed. After some observations of a general character on the development of nuclear power in Great Britain, especially the generation of electric power and the present state of gas-cooled reactors, the technical aspects of this reactor type are described. The principal characteristics are summarized, with emphasis on the fuel and design problems, construction, and operational installation. The economic aspects of the GCR are considered; the installation costs, fuel costs, and operational and maintenance costs were studied on the assumption of the future construction of a GCR in Argentina. (tr-auth)

45026 (NP-14290(Pt.A)) GENERAL INFORMATION IN SUPPORT OF APPLICATION FOR CONSTRUCTION PERMIT AND LICENSE, MALIBU NUCLEAR PLANT UNIT NO. 1. (Los Angeles. Dept. of Water and Power). Nov. 1963. 49p. (DOCKET-50-214)

General information is given on economic and technical capabilities of the Department of Water and Power of the City of Los Angeles. (R.E.U.)

45027 (NP-14368) O.E.C.D. HIGH-TEMPERATURE REACTOR PROJECT DRAGON. FIFTH ANNUAL REPORT, 1963—1964. (European Nuclear Energy Agency, Paris). 100p.

Abstracts are presented on two sections of this report dealing with research and development and reactor design and construction. Other sections containing information on technical and economic aspects, administration, contracts placed, expenditure and commitments estimates, patents and liscensing, collaboration with other atomic energy agencies, personnel, and assessment work are summarized. (N.W.R.)

For abstracts of individual sections see: 45028 and 45029.

45028 (NP-14368(p.17-34)) RESEARCH AND DEVELOPMENT. (European Nuclear Energy Agency, Paris).

Research and development of materials and components for the Dragon Reactor are summarized. Information is included on: reactor physics, engineering research, reactor safety assessment, carbon transport, coolant processing, fuel element development and testing, graphite development and properties, irradiation experiments, fission product studies, bearing and seal development and testing, and control system development. (N.W.R.)

45029 (NP-14368(p.36-67) REACTOR DESIGN AND CONSTRUCTION. (European Nuclear Energy Agency, Paris).

Design and construction of the Dragon Reactor are discussed. Information is included on: primary circuit, instrumentation, heat removal equipment, containment and ventilation, water supplies, fuel handling, fission product trapping and helium purification, reactor construction, site testing, remote handling equipment, and secondary and tertiary circuits. (N.W.R.)

45030 (ORNL-P-365) THE FUELING OF NUCLEAR POWER COMPLEXES. Gale Young (Oak Ridge National Lab., Tenn.). Aug. 24, 1964. Contract W-7405-eng-26. 32p. (CONF-714-1)

From Conference on Nuclear Education in the New Era of Nuclear Power, Gatlinburg, Tenn., Aug. 1964.

Fuel economics and future prospects for dual-purpose nuclear power plants are discussed. (R.E.U.)

45031 (SRO-106) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, AUGUST 1964. (Savannah River Operations Office, AEC). 6p.

Development of fog-cooled reactors, fuel elements, reactor materials, and heavy water power reactors is summarized. Information is included on: CANDU Reactor fuel element testing, HWCTR operation and fuel element fabrication, CVTR operation, ductility of zirconium tubes, and heat transfer and fluid flow studies. (N.W.R.)

45032 (SRO-107) HEAVY WATER POWER REACTOR PROGRAM MONTHLY PROGRESS REPORT, SEPTEMBER 1964. (Savannah River Operations Office, AEC). 8p.

Development of fog-cooled reactors, fuel elements, reactor materials, and heavy water power reactors is summarized. Information is included on: CANDU Reactor fuel element testing, HWCTR operation and fuel element fabrication, CVTR operation, ductility of zirconium tubes, and heat transfer and fluid flow studies. (N.W.R.)

45033 (TID-21188) HALLAM NUCLEAR POWER FACILITY MONTHLY OPERATING REPORT NO. 24, JULY 1964. R. E. Durand and I. O. Sunderman, eds. (Consumers Public Power District, Hallam, Nebr.). Contract [AT(11-1)-513]. 65p.

The operation and performance of the Hallam power reactor are summarized. Information is included on: plant performance, sodium purity, carbon trap performance, control rod difficulties, plant protective system testing, fuel element orifice adjustment, throttle valve performance, reactivity, cavity cooling coil leak testing, radiation control, waste disposal, maintenance, and modifications of throttle valve drive position indicator, spent fuel storage pit, flux controller, and inspection methods. (N.W.R.)

45034 (WAPD-MRP-109) PRESSURIZED WATER REACTOR (PWR) PROJECT. Technical Progress Report, April 24–July 23, 1964. (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh). Contract AT(11-1)-Gen-14. 133p.

Progress on the Shippingport Pressurized Water Reactor is reported. Topics covered include: plant modification, plant decontamination, refueling, reactor engineering, metallurgy of core materials, core operation, and reactor physics. (N.W.R.)

45035 (WCAP-2647) NINTH AND TENTH QUARTERLY PROGRESS REPORT FOR 1000 MWe SUPERCRITICAL PRESSURE NUCLEAR REACTOR PLANT STUDY. H. B. Kellogg, comp. and ed. (Westinghouse Electric Corp. Atomic Power Div., Pittsburgh). Aug. 1964. Contract AT(30-1)-2948. 42p.

Fabrication and development of corrosion test sections were continued. Two loop shakedown runs were completed. As a result of actual operation under supercritical conditions, several changes were made to the test sections, including replacement of the nickel end conductor material with copper and the development of welded rather than brazed joints for the Hoskin-nickel and nickel-copper heater connections. (auth)

45036 (JPRS-26497) PRELIMINARY TECHNICAL-ECONOMIC ESTIMATES ON COMPLEX UTILIZATION OF NUCLEAR POWER FOR DESALINATION OF SALT WATER AND SIMULTANEOUS GENERATION OF ELECTRIC POWER. N. M. Sinev. Translation of an address presented at a conference on "Utilization of Atomic Energy," Washington, D. C., August 16, 1964. 32p. (TT-64-41755)

Economic and technical aspects of dual-purpose desalination-power plants using several types of reactors are discussed. Fast-neutron, water-cooled and -moderated, water-graphite, and heavy water reactors are considered. It is shown that a fast reactor of 2,200 Mw(t) output is the most economical for desalination of 180,000 to 220,000 m^3 of sea water per day. (R.E.U.)

45037 CONCRETES FOR BIOLOGICAL SHIELDS OF POWER REACTORS. Emanuele Fumagalli. Energia Elettrica, 37: 9p.(1960). (In Italian)

In relation to the technological problems connected with the realization of shields for reactor radiation, and taking into consideration the principal data of nuclear physics, criteria for the composition and selection of the cement conglomerates most suitable are examined. Experimental results that show the physical-mechanical characteristics of the material itself are also described. (tr-auth)

45038 ON THE DISTRIBUTION OF SOME FISSION PRODUCTS BETWEEN CORE AND RECOMBINER OF L54 REACTOR. PART 2. ON THE TRANSPORT OF DELAYED NEUTRON PRECURSORS IN THE RECOMBINER. E. Lazzarini, V. Sangiust, and M. Terrani (CESNEF, Milan). Energia Nucl. (Milan), 11: 495-504(Sept. 1964).

The transfer of delayed neutron precursors from the core to the recombiner of the L54 reactor, a water boiler homogeneous reactor, was investigated. The neutron flux due to the decays of the delayed neutron precursors in recombiner was studied in relation to the power and temperature at which the reactor operates. The neutron flux in the gamma irradiation facilities of the recombiner was mapped and the Cd ratios for Mn were determined. The highest value of the neutron flux at the maximum power (50 kw) and temperature (90°C) is $(0.83 \pm 0.03) \times 10^6$ neutrons/$(cm^2 \cdot s)$. It was found that a rapid increase of the release of delayed neutron precursors takes place after the reactor scram. This effect was studied in relation to the power and temperature at which the reactor operated before the scram. It is due to oxidation of iodide present in the core by H_2O_2 coming from radiolytic processes. It was found that only iodine delayed neutron precursors are present in recombiner, but not those of bromine. A qualitative interpretation of the transfer process of delayed neutron precursors from core to recombiner is worked out. (auth)

45039 FUEL RELOADING AT THE DRESDEN CENTER. Murray Joslin (Commonwealth Edison Co., Chicago). Ind. At., 8: No. 7-8, 95-102(1964). (In French)

The first refueling of Dresden Nuclear Power Station is described. After correction of problems encountered during startup and initial operation, the plant was highly dependable. The shutdown provided an opportunity to confirm, among other things: condition of core support grid plate, integrity and worth of control rods, condition of control drive mechanism, and adequacy of moisture separation features of the turbine. The work of refueling is described in some detail. Also described are the tools and fixtures used in handling and inspecting radioactive items under water. (auth)

45040 TWIN 500 Mw NUCLEAR REACTORS FOR ONTARIO. Mod. Power Eng., 60-3(Sept. 1964).

The proposed Fairport power plant is briefly described, including the site, safety aspects, and operating parameters. Heavy water coolant will transfer heat to eight boilers

with a cycle efficiency of about 33.5%. The fuel cost and overall power cost are estimated to be 0.7 mills/kwh and <4 mills/kwh, respectively. (D.C.W.)

45041 THE ÅGESTA REACTOR. B. McHugh. Nucl. Energy, 252-61(Sept. 1964).

A description of the plant layout, turbine hall, control room, pressure vessel, vessel internal fittings, fuel assemblies, rods and mechanisms, coolant loops, steam plant, major auxiliary systems, water volume control and drain system, and purification and chemical control system of the Agesta Reactor is presented. (C.E.S.)

45042 NATIONAL PLANS FOR NUCLEAR POWER. Manson Benedict. Nucl. News, 7: No. 10, 14-19(Oct. 1964).

A summary is given of the Geneva Converence papers that outlined plans for nuclear power development in the countries of Australia, U.S.S.R., Canada, Czechoslovakia, United Arab Republic, Sweden, Japan, Portugal, Spain, France, Argentina, Brazil, United States, United Kingdom, Pakistan, and India. (C.E.S.)

45043 FAST-REACTOR PROGRAMS. W. Haefele and P. Engelmann. Nucl. News, 7: No. 10, 29-32(Oct. 1964).

A summary is given of the Geneva Conference papers on fast-reactor programs in the U.S.S.R., U.S.A., United Kingdom, France, Germany, Italy, and Euratom. (C.E.S.)

45044 DIRECT CONVERSION. W. E. Shoupp and J. H. Bach. Nucl. News, 7: No. 10, 50-2(Oct. 1964).

A summary is given of Geneva Conference papers on thermoelectric, thermionic, and magnetohydrodynamic conversion systems for use with reactors. (C.E.S.)

45045 NUCLEAR DESALINATION ASPECTS. R. P. Hammond. Nucl. News, 7: No. 10, 55-6(Oct. 1964).

A summary is given of the Geneva Conference papers on the development of power reactors for desalination purposes. (C.E.S.)

45046 PRESSURIZED-WATER-REACTOR TECHNOLOGY. Joseph Rengel. Nucl. News, 7: No. 10, 66-8(Oct. 1964).

A summary is given of Geneva Conference papers on the development of pressurized-water reactors. (C.E.S.)

45047 BOILING-WATER REACTOR TECHNOLOGY. G. White and R. B. Richards. Nucl. News, 7: No. 10, 70-1(Oct. 1964).

A summary is given of the Geneva Conference papers on the operating experience, technology status, and economics of boiling-water reactors. (C.E.S.)

45048 GAS-COOLED-REACTOR TECHNOLOGY. C. L. Rickard, G. Melese, and P. Fortescue. Nucl. News, 7: No. 10, 73-5(Oct. 1964).

A summary is given of Geneva Conference papers on high-temperature gas-cooled reactors, the stainless steel clad UO_2-graphite reactor, the natural-uranium CO_2-cooled reactors, components and design, reactor experiments, and the gas-cooled fast-breeder reactor. (C.E.S.)

45049 HEAVY-WATER AND ORGANIC REACTOR TECHNOLOGY. J. W. Landis, A. H. Lazar, James C. Deddens, and H. Pearlman. Nucl. News, 7: No. 10, 76-9 (Oct. 1964).

A summary is given of the Geneva Conference papers on heavy-water and organic reactor technology in Canada, the United Kingdom, Scandinavia, France, Switzerland, Italy, Spain, the U.S.S.R., and the U.S.A. (C.E.S.)

45050 SODIUM THERMAL REACTOR TECHNOLOGY. C. Starr. Nucl. News, 7: No. 10, 81-4(Oct. 1964).

A summary is given of Geneva Conference papers on the SCR design, uranium carbide fuel, sodium components, solid moderators, liquid metal heat transfer, corrosion in liquid metal systems, and the Interatom sodium zirconium hydride reactor. (C.E.S.)

45051 NUCLEAR SUPERHEAT. J. H. Wright. Nucl. News, 7: No. 10, 85-6(Oct. 1964).

A summary is given of the Geneva Conference papers on the development of nuclear superheat in the U.S.S.R., Sweden, Germany, and the U. S. A. (C.E.S.)

45052 ECONOMICS OF FUEL CYCLES. H. Parker, E. A. Eschbach, and E. A. Evans. Nucl. News, 7: No. 10, 88-9(Oct. 1964).

A summary is given of Geneva Conference papers on fuel cycle economics and the contribution of fuel-fabrication costs to overall fuel-cycle costs. (C.E.S.)

45053 THE PROGRAM FOR BREEDERS—THE ECONOMIC FAST BREEDER—SOON? A. P. Donnell. Nucl. News, 7: No. 10, 104-6(Oct. 1964).

The projections made at the Geneva Conference, which postulated a developmental period of 20 to 25 years for the economic fast breeder reactor are challenged, and some of the factors involved in the estimates are considered. (C.E.S.)

45054 THE PROGRAM FOR BREEDERS—BREEDERS—WHEN—OR NEVER! W. B. Lewis. Nucl. News, 7: No. 10, 107-10(Oct. 1964).

It is shown that the population of the world can derive low-cost power from nuclear sources for many centuries or even indefinitely even without the development of breeder reactors. The availability of ^{235}U, power needs, the contribution of fuel to the cost of power, the limitations of fast reactors, and reactors for the $^{235}U-Th-^{233}U$ cycle are discussed. (C.E.S.)

45055 POWER-REACTOR STABILITY. P. N. Haubenreich. Nucl. Safety, 5: 354-6(1964).

Information concerning stability in power reactors is reviewed. Stability parameters for use in design are discussed along with determination of stability in new reactors by exploratory operation. (J.R.D.)

45056 ACTION ON REACTOR PROJECTS UNDERGOING REGULATORY REVIEW. J. R. Buchanan. Nucl. Safety, 5: 410-19(1964).

It is noted that the AEC is required by Federal regulations to authorize operation of and changes in U. S. nuclear facilities. A record concerning the license applications of various power reactors is tabulated. (J.R.D.)

45057 THE APPLICATION OF INHOUR MODES TO THE DESCRIPTION OF NON-SEPARABLE REACTOR TRANSIENTS. A. F. Henry (Westinghouse Electric Corp., Pittsburgh). Nucl. Sci. Eng., 20: 338-51(Nov. 1964). (WAPD-T-1671)

For a large power reactor it appears possible to describe non-separable space-time kinetics transients in terms of a particular set of spatial harmonics to be called inhour modes. These modes are defined as a subset of the period modes obtained by assuming a separable time variation $e^{\omega t}$ for all variables in the source-free, time-dependent neutron and neutron-precursor equations. Their use is appropriate whenever details of the neutron energy and angular behavior are not required. Inhour modes are shown to occur in clusters of seven, the seven eigenvalues of a given cluster being obtained as the roots of an inhour equation appropriate to the cluster. The neutron flux shapes associated with a particular cluster of seven modes

are all approximately the same. It is shown that if these shapes are assumed to be identical, certain useful orthogonality relations and certain identities involving the roots of the inhour formula for a given cluster are obtained. Use of these results simplifies the extension of the conventional equations of reactor kinetics to the nonseparable case. Inhour modes are also useful in analyzing certain experiments involving subcritical assemblies. As an illustration, application to the source-jerk and pulsed-source experiments is made. (auth)

45058 PROCEEDINGS OF THE ANGLO-JAPANESE NUCLEAR POWER SYMPOSIUM, TOKYO, MARCH 1963. VOLUMES 1 AND 2. Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 1963, 1-2: 1-451. [Tokyo, Japan Atomic Industrial Forum and London, United Kingdom Atomic Energy Authority].

Progress on Tokai Generating Station, operational experience and improvements in performance of Calder Hall and Chapelcross Reactors, the Berkeley and Bradwell Power Stations, experience obtained on Tokai Power Project, the British nuclear power program, twin reactor stations at Sizewell, Oldbury Power Station, the Wylfa A-1 Reactor, fuel and fuel cycles for magnox reactors, present status of nuclear fuels research and development in Japan, reprocessing of irradiated fuel in the United Kingdom, graphite performance, research and development of nuclear graphite in Japan, plutonium in thermal reactors, the Advanced Gas-Cooled Reactor, experience in operating a power-producing fast reactor, and the role of safety in the progressive development of power reactors are discussed. Separate abstracts are prepared for 11 of the 17 abstracts presented. Abstracts of 6 papers previously appeared in NSA (18: 41942, 42970, 43048, 43049, 43050, and 43051). (C.E.S.)

For abstracts of individual papers see: 43725, 44079, 45059, 45060, 45061, 45062, 45063, 45064, 45065, 45066, and 45067.

45059 PROGRESS ON TOKAI GENERATING STATION. Toshio Takaichi (Tokyo Construction Office and Fuji Electric Mfg. Co. Ltd., Japan) and I. A. B. Gaunt. Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 1963, 1: 15-42.

The design, construction techniques, personnel training, and work progress of the Tokai-Mura Power Reactor are discussed. (C.E.S.)

45060 OPERATIONAL EXPERIENCE AND IMPROVEMENTS IN THE PERFORMANCE OF THE CALDER HALL AND CHAPELCROSS REACTORS AND THEIR USE AS AN IRRADIATION TESTING FACILITY FOR PROTOTYPE FUEL ELEMENTS. R. McKeague (Atomic Energy Authority, [Harwell, Berks, Eng.]). Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 1963, 1: 43-60.

It was shown, by the extensive operating experience that was accumulated at Calder Hall and Chapelcross, that even with the restrictions imposed by the very high safety standards, and the extent to which they are utilized as major irradiation test facilities, very high overall load factors can be maintained and the plants can be operated as reliably as conventional power stations. The large scale irradiation experience under actual operating conditions represents a convincing demonstration of the expected performance and long term endurance of uranium metal, magnesium alloy clad fuel elements. It seems likely that operators of British magnox designated reactors will eventually be expecting fuel irradiation lifetimes of 4-5000 Mwd/te. (C.E.S.)

45061 THE BERKELEY AND BRADWELL NUCLEAR POWER STATIONS. D. R. R. Fair (Central Electricity Generating Board, [London]) and E. Anderson. Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 1963, 1: 61-83.

The organization set up to supervise various aspects of the Berkeley and Bradwell stations is discussed, and aspects of interest in the commissioning and initial operation of the stations are described. Staffing and training, the commissioning organization, safety, the commissioning program, mechanical testing, instrumentation and safety circuits, control rod calibration, flux shaping and coolant flow distribution, fuel integrity tests, and startup performance are considered. (C.E.S.)

45062 EXPERIENCE OBTAINED ON TOKAI ATOMIC POWER PROJECT. Katsuji Fukuda (Japan Atomic Power Co., [Tokyo]), Toshio Yoshioka, Susumu Tsujimoto, and Ichiro Watanabe. Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 1963, 1: 85-105.

A chronological review of designing and construction of the Tokai Power Station is presented. Radiation control, reactor control characteristics, safety design, aseismatic design, staff training, meteorological surveys, studies on graphite, fuels, and brittle fracture of steel, and economic aspects are discussed. (C.E.S.)

45063 THE BRITISH NUCLEAR POWER PROGRAMME. D. R. Berridge (Central Electricity Generating Board, [London]). Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 1963, 1: 109-18.

The experience and knowledge gained during the design, construction, commissioning, and early operation of the first nuclear stations are discussed. (C.E.S.)

45064 TWIN REACTOR STATIONS AT SIZEWELL. H. S. Arms (English Electric Co. Ltd., [Whetstone, Leics, Eng.]). Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 1963, 1: 119-31.

The site layout of the Calder Hall type reactors is discussed with particular emphasis on the twin reactor stations at Sizewell. (C.E.S.)

45065 OLDBURY POWER STATION. R. D. Vaughan. Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 1963, 1: 133-52.

A description of the concrete pressure vessel, the reactor core, boilers, gas circulation, reactor facilities, and generating plant is presented. (C.E.S.)

45066 THE WYLFA A-1 REACTOR. J. W. Ashley (United Power Co. Ltd., [London]). Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 1963, 1: 153-76.

Basic design decisions, special features of the design, safety considerations, and special requirements to suit Japanese conditions are discussed. (C.E.S.)

45067 FUEL AND FUEL CYCLES FOR MAGNOX REACTORS. D. R. R. Fair (Central Electricity Generating Board, [London]) and N. L. Franklin. Proc. Anglo-Japan. Nucl. Power Symp., Tokyo, 1963, 1: 185-215.

Fuel elements based upon metallic uranium enclosed in Magnox cans that are used in the Calder Hall type reactors are discussed. The design and performance features are considered. That part of the fuel cycle that deals with the strategy of fuel movement or replacement within the reactor and the consequences of various strategies to reactor output and fuel utilization are discussed. Demands upon fuel handling equipment are also considered. (C.E.S.)

45068 STUDY OF A REACTOR POWER CONTROL BY ACTING ON THE COOLANT FLOW, THE INLET AND OUTLET TEMPERATURE BEING CONSTANT. Pierre Barbaste. p.175-83 of "Comptes Rendus des Journées sur le Contrôle Optimum et les Systèmes Non-Linéaires – Saclay – 13-15 June 1962." (EUR 1652.f). (In French)

A model considered as representative of a power reactor channel is presented. In this model the heat generated in the fuel is evacuated by a coolant after having passed through n material layers. From an analytical point of view, this model is described by a non-linear set of (n + 1) differential equations of first order. This set of equations describes the time behavior of the model after perturbations on the coolant mass flow and the reactivity, the channel inlet temperature being supposed to be constant; it includes the kinetic behavior of the channel as well from the neutronic point of view as from the thermal one. Then one obtains the formulas which give the variations of the different variables (power, temperatures) between an initial state and the final state which is reached after introduction of the different perturbations. These formulas are utilized to study the control of the power of such a channel by acting on the reactivity and the coolant mass flow. Particularly one obtains the equation which must be satisfied by the introduced reactivity and the mass flow variation, respectively, so that the power variation occurs without the outlet temperature being modified. A numerical example is given for an ORGEL type reactor. (auth)

45069 AN INVESTIGATION OF NUCLEAR EXCURSIONS TO DETERMINE THE SELF-SHUTDOWN EFFECTS IN THERMAL, HETEROGENEOUS, HIGHLY ENRICHED, LIQUID-MODERATED REACTORS. John Robert Fagan. Thesis, Manhattan, Kan., Kansas State Univ., 1962. Kansas State Univ., Eng. Expt. Sta., Spec. Rept., No. 23, 1-122 (1962).

Transient reactor experiments, such as the SPERT tests, have demonstrated that thermal, heterogeneous, liquid-moderated reactor systems will safely shut themselves down following step and ramp insertions of limited amounts of excess reactivity. Equations for the fine structure of the temperature distribution in a unit cell of a heterogeneous reactor during a transient burst were derived based on the known power and fuel surface temperature distributions. A model based on recognized shutdown effects was developed to calculate the excess reactivity during a transient using the temperature distributions to define the deposition of energy. The calculated excess reactivities show this model to be satisfactory. The effect on reactivity due to steam formation required one empirical parameter which can probably be removed when a greater knowledge of transient boiling is available. (auth)

45070 DEUTSCHE REAKTOREN UND RAUMFAHRT-PROJEKTE. (German Reactor and Rocket Project). Bonn Deutsches Atomforum e. V., 1963. 66p.

The developing utilization of nuclear energy is reviewed. Scientific research as an urgent task for govenments is discussed. The present state of development of power reactors in the West German Republic is described. The European space vehicle development and the German contribution to space flight are discussed. (J.S.R.)

45071 PROCESS AND INSTALLATION FOR THE PRODUCTION OF SUPERHEATED STEAM. (to Babcock and Wilcox Ltd.). French Patent 1,288,316. Feb. 12, 1962. Priority date Mar. 22, 1960, Great Britain.

The process for production of superheated steam consists in supplying in a controlled manner the working medium in liquid phase to a unit for producing superheated steam, in providing forced circulation of the reactor coolant through the reactor core and the superheater unit, in controlling heat development within the core to hold the reactor outlet temperature essentially constant, and in controlling the supply of the superheater unit by a quantity formed by a comparison of the measured value of the reactor coolant flow with the measured value of the working medium flow passing through the unit. (IIB)

45072 NUCLEAR POWER REACTOR COMPRISING BAR SHAPED FUEL ELEMENTS. (to Beteiligungs- und Patentverwaltungs GmbH). French Patent 1,336,626. July 22, 1963. Filed Oct. 22, 1962.

A nuclear reactor was designed with bar-shaped fuel elements horizontally disposed and assembled in series with the aid of vertical beams, so as to form ladder-like units. The fuel elements and the beams are hollow in order to form a passage for the coolant. This disposition was developed for use in a boiling-water reactor where the ladder-like units are submerged within the boiling water, while the steam formed enters the assembly via the open upper extremity of one beam, and the other beam serves as outlet header for the superheated steam. The reactor may also be cooled by a gas passing through the annular interstice of a double cooled graphite sleeve enclosing a uranium rod. (IIB)

45073 NUCLEAR THERMAL INSTALLATION ESPECIALLY FOR POWER PLANT. (to Electricite de France). French Patent 1,345,745. Nov. 4, 1963. Filed Oct. 31, 1962.

A nuclear thermal installation was designed, which consists of a pressure vessel with vertical axis enclosing an inner shell, the inner space of which is subdivided into an upper and a lower compartment. The upper compartment encloses the reactor core, while the lower consists of a heat exchanger protected from the radiation of the core by a biological shield. The primary fluid flows downward through the channels of the core and passes openings in the shield before flowing through the heat exchanger. The primary fluid is recycled with the aid of blowers by an upward flow passing through the annular interspace formed between the pressure vessel wall and the inner shell. The heat exchanger is formed by an assembly of units each adapted to be by-passed, the number of elements being greater than necessary for normal operation. The blowers, disposed downstream the heat exchanger, are mounted in cavities of the pressure vessel wall and driven by means outside the vessel. (IIB)

Production Reactors

45074 (HW-SA-3690) MULTI-CHANNEL FLOW MONITOR FOR N-REACTOR PROCESS TUBE COOLANT. J. D. McCullough (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 20, 1964. Contract AT(45-1)-1350. 25p. (CONF-750-1)

From Meeting of Richland Section—Instrument Society of America, Richland, Wash., Sept. 1964.

A description is given of the process tube coolant flow monitor system currently installed in the N-Reactor (NPR) at Hanford, Washington. The system monitors, within extremely close limits, the individual flows through each of the 1004 reactor process tubes and initiates a reactor shutdown within one second after detection of any abnormal flow condition. Differential pressure signals from Venturi tubes in the coolant supply lines to each process tube are converted to electrical signals by differential pressure transducers. The electrical signals are compared to low and high flow trip references by limit controllers. The outputs of the controllers are then combined and transmitted to trip timers whose outputs become part of the reactor safety system. The basic flow monitor designed to comply with functional and accuracy requirements is first described. This is followed by a description of the redundancy and

self-check techniques employed to provide the necessary high level of reliability. (auth)

Propulsion and Space

45075 (NAA-SR-Memo-8685) SNAP PRELAUNCH TEST FACILITY SAFEGUARDS REPORT. B. F. Ureda (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.). Dec. 31, 1963. Contract AT(11-1)-Gen-8. 102p.

Safety considerations pursuant to the SNAP 10A program to be conducted in the SNAP Prelaunch Test Facility (SPTF) at Vandenberg AF Base are shown to insure operational safety. The location and design of the facility, selection of operating equipment, limitation to non-nuclear operation, and definition and control of operating procedures are considered. The MCA is postulated as a NaK fire in the immediate vicinity of the core; reactor criticality is judged to be incredible. (R.E.U.)

45076 (ORNL-3670(p.225-7)) SPACE POWER PROGRAM. W. C. Thurber (Oak Ridge National Lab., Tenn.).

Materials assistance is being provided for the Medium Power Reactor Experiment, a compact boiling-potassium system for electric power generation. Work has included fabrication of components for experimental devices, preparation of fuel element specifications as well as associated fabrication development, and posttest metallurgical analyses of various items of hardware. (auth)

45077 PROBLEM: STANDARDIZING INSTRUMENTS—SOLUTION: DIGITAL SYSTEMS. Donald Gertz and Lionel Leavitt (Ford Instrument Co., Long Island City, N. Y.). Electronics, 37: No. 27, 65-70(Oct. 19, 1964).

Digital transducers are used as back-up monitors for temperature, pressure, and water level in the power-generating system of the Savannah. Ultrasonic pulses are used as switching or coupling signals. The digital sensors, ultrasonic system, receiver circuit, information display, and data recording system are described, together with multiplexing of the circuits. (D.C.W.)

45078 RESEARCH AND TEST REACTORS. D. R. deBoisblanc. Nucl. News, 7: No. 10, 58-63(Oct. 1964).

A summary is given of the Geneva Conference papers on the development and uses of research and test reactors in the U.S.S.R., France, Canada, and the U.S.A. (C.E.S.)

Research and Test Reactors

Refer also to abstract 44974.

45079 (ANL-6936(p.1-16)) BOILING WATER REACTORS. (Argonne National Lab., Ill.).

Operation of the Borax-v reactor is summarized, and experiments concerning defective superheater fuels, defective boiler fuels, boiling fuel rod central temperatures, and neutron flux distribution in Borax-v are discussed. Water chemistry parameter measurements are included. (J.R.D.)

45080 (ANL-6936(p.73-6)) ADVANCED SYSTEMS RESEARCH AND DEVELOPMENT. (Argonne National Lab., Ill.).

The design, physics calculations, and experimental facilities for the Argonne Advanced Reactor are reviewed. Other work is reported on MHD Power generation and regenerative EMF cells. (J.R.D.)

45081 (CEA-R-2533) CONTROLE DE PUISSANCE DES PILES A EAU PAR MESURE D'ACTIVITE EN AZOTE 16. (Power Control of Water Reactors Using Nitrogen 16 Activity Measurements). Roger Gariod, Francis Merchie, and Guy O'Byrne (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble). May 12, 1964. 16p.

At the GRENOBLE Nuclear Research Center, the open-core swimming pool reactors MELUSINE (2 Mw) and SILOE (15 Mw) are controlled at a constant overall power using nitrogen-16 channels. The conventional linear control channels react instantaneously to the rapid power fluctuations, this being necessary for the safety of the reactors, but their power indications are erroneous since they are affected by local deformations of the thermal flux caused by the compensation movements of the control rods. The nitrogen-16 channels on the other hand give an indication of the overall power proportional to the mean fission flux and independent of the rod movements, but their response time is 15 seconds. A constant overall power control is thus possible by a slow correction of the reference signal given by the automatic control governed by the linear channels by means of a correction term given by the "N-16" channels. This is done automatically in MELUSINE and manually in SILOE. (auth)

45082 (HMI-B-36) ZUM KINETISCHEN VERHALTEN DES BER. (About the Kinetic Behavior of the BER). R. Schroeder (Hahn-Meitner-Institut fur Kernforschung, Berlin). Aug. 1964. 59p.

The kinetic behavior of the water boiler reactor BER was investigated by the pile oscillator technique. This report presents some possibilities to refine the theoretical models which describe the reactor transfer function. The void coefficient of reactivity was measured and its value as well as the bubble lifetime and the prompt neutron lifetime are presented. Operating at 50 kw, the reactor power oscillates with a rather constant frequency. The performed experiments have shown that probably no function correlation exists between these oscillations and the behavior of the transfer function. Under the assumption that,these oscillations are created by oscillation of the bubble volume, the magnitude of this effect was calculated. The behavior of the reactor is discussed for an extrapolation of the reactor power up to 250 kw. (auth)

45083 (HW-80021) FRETTING CORROSION IN THE PLUTONIUM RECYCLE TEST REACTOR. W. K. Winegardner (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Mar. 1964. Contract AT(45-1)-1350. 34p.

In-reactor examination of the interior surface of the vertically oriented, Zircaloy-2 pressure tubes of the Plutonium Recycle Test Reactor (PRTR) has revealed corrosion, termed fretting corrosion or fretting attack, at the points of contact between the fuel elements and pressure tubes. Examination of all of the 85 pressure tubes after the first year of power operation revealed approximately 1600 corrosion areas and that 2.2% of the areas were deeper than 0.010 in. The maximum penetration observed was 0.026 in. Subsequent examinations have shown that although approximately 1700 new areas have been formed, the depth of penetration is decreasing. The decreased severity has been attributed to the use of increased contact area and decreased vibration. Results are summarized of programs designed to detect and determine the extent of the in-reactor attack and of out-of-reactor tests which were conducted to better define the attack. Possible mechanisms for the attack and conditions that result in deep penetrations are discussed. (auth)

45084 (IA-919) AUTOMATIC LOADING EQUIPMENT FOR A REACTOR THERMAL COLUMN. I. Balla and G. Ben-David (Israel. Atomic Energy Commission. Soreq Research Establishment, Rehovoth). Apr. 1964. 10p.

Automatic loading equipment is described for the thermal column of the Israel Research Reactor IRR-1. The equipment permits experiments to be loaded and removed from the thermal column while the reactor is in operation. (auth)

45085 (ORNL-3670(p.163-5)) ADVANCED TEST REACTOR. R. J. Beaver and G. M. Adamson, Jr. (Oak Ridge National Lab., Tenn.).

The Advanced Test Reactor Aluminum-Base Fuel Element Program was completed during the past year. The majority of effort was directed at the collection and publication of the detailed results obtained in developing this mechanically joined 19-plate, wedge-shaped fuel element. Evaluation of the homogeneity of the fuel in the ATR plates by x-ray attenuation techniques was completed. Mixtures containing 34.57% U_3O_8 in aluminum made acceptable fuel-plate cores when the U_3O_8 particle size was restricted to -170 +325 mesh. (auth)

45086 (ORNL-3670(p.201-15)) HIGH-FLUX ISOTOPE REACTOR. G. M. Adamson, Jr. (Oak Ridge National Lab., Tenn.).

Fuel and control elements are being developed for the High Flux Isotope Reactor, a reactor being built to operate at a flux of 5×10^{15} neutrons cm^{-2} sec^{-1} to produce transplutonium elements. Development of the novel fuel element has progressed to the point that a contract has been issued for the first year's supply. Excellent bonding and dimensional control was achieved in two complete sets of fuel plates, one for a critical experiment and one for the first reactor core. Excellent control was achieved on both plate dimensions and nonbond. In general, no difficulty was encountered in meeting the +30% tolerance for any $\frac{5}{64}$-in.-dia area, but some relaxation will be required for the ±10% tolerance for the "average" in short strips. The set for the critical experiment has been formed to the required involute shape and assembled without difficulty into the element. Perfecting the welding procedures continues to be one of the major HFIR problems. Attachment of fuel plates into the element was improved by an increase in the root thickness and new sequences for the start and finish of each weld. A new instrument has been developed, built, and demonstrated for measuring uranium homogeneity in fuel plates. From the x-ray attenuation it continuously measures concentration in areas as small as $\frac{1}{64}$ in. in diameter at scanning speeds of 130 in./min or "average" concentration in short lengths. Cylindrical control assemblies containing separate dispersions of europium oxide and tantalum in aluminum were fabricated to close tolerances. Control plates were roll clad, mechanically formed into approximately the desired cylindrical quadrants, explosively formed to the specified dimensions, and welded in groups of four to form the cylindrical elements. During preforming, cracking in the europium section was prevented by use of a backup plate to keep the section in compression. (auth)

45087 (ORNL-P-325) HIGH FLUX ISOTOPE REACTOR. J. R. McWherter (Oak Ridge National Lab., Tenn.). [196?]. Contract W-7405-eng-26. 15p. (CONF-739-1)

From U. S. Army Nuclear Science Seminar, Oak Ridge, Tenn., Aug. 1964.

The ORNL High Flux Isotope Reactor and its purpose are described. Production rate predictions for transplutonium isotopes are given. (R.E.U.)

45088 (ORNL-TM-627) REPORT ON FUEL-PLATE MELTING AT THE OAK RIDGE RESEARCH REACTOR, JULY 1, 1963. T. M. Sims and W. H. Tabor (Oak Ridge National Lab., Tenn.). Oct. 1964. Contract W-7405-eng-26. 60p.

During the night of June 30–July 1, 1963, some fission products were released from the Oak Ridge Research Reactor fuel into the water systems. The incident occurred at a power of 24 Mw during a beginning-of-cycle startup. It was discovered later that the fission-product release was caused by the blocking of one fuel element by a large neoprene gasket. The release from the fuel element was of short duration, probably less than one or two minutes. There is some evidence that a major portion of the release terminated prior to the reduction of the reactor power from 24 Mw. A preliminary estimate, based on the gross β-γ activity level of the first sample taken from the reactor water system subsequent to the release, indicated a release of the order of 1000 Curies. Only volatile fission products escaped in significant quantities from the fuel element into the water system. Diffusion of noble gas isotopes (principally ^{138}Xe and ^{88}Kr) from the water system to the building atmosphere resulted in some contamination of the latter with ^{138}Cs and ^{88}Rb at levels estimated at 10^{-6} to 10^{-7} $\mu C/cm^3$. Stack monitors indicated that most of the radioactivity discharged from the facility came through the central off-gas system via the primary water degasifier. The integrating sampler in the stack discharge showed that about 150 to 200 mC of iodine were released, although most of the contamination in the off-gas was removed by the filters and scrubber. Contamination in the water was removed by the demineralizers and eventually discharged into the Intermediate-Level Waste System. The reactor shutdown and subsequent fuel plate location are discussed. (auth)

45089 (ORNL-TM-914) ORR OPERATIONS FOR PERIOD APRIL 1963 TO APRIL 1964. W. R. Casto and W. H. Tabor (Oak Ridge National Lab., Tenn.). Oct. 1964. Contract W-7405-eng-26. 112p.

During the year, a fuel meltdown incident occurred and irradiation damage of beryllium reflectors was discovered. In spite of these incidents, improvement in control-system and process-system maintenance permitted operation of the reactor 82.9% of the time. Important changes were made in the control system where redesigned fission chambers were installed and a new rod drive is being tested. Experiment facilities were utilized almost 100%. The installation of hydraulic tube No. 2 in a higher flux area and with a large sample capacity has resulted in a considerable increase in the number of samples irradiated. (N.W.R.)

45090 (PAN-103/IX) PRELIMINARY DESIGN OF THE BURST SLUG DETECTION SYSTEM FOR THE II-nd POLISH REACTOR. Jadwiga Jabłońska, Andrzej Janikowski, and Krystyna Józefowicz (Polish Academy of Sciences. Inst. of Nuclear Research, Swierk). Mar. 1963. 13p.

Discussion leading to the choice of adequate methods for the detection of leakage in fuel elements is given with a short description of the applied techniques. It is foreseen that the fission-product activity in the coolant stream will be measured with a few different methods. The fault-spot location in the particular fuel element will be determined using delayed neutron detection technique in separate reactor channels. An outline of the program for in-pile loop experiments in a graphite-water moderated, water cooled enriched reactor is given. (auth)

45091 (PAN-416/XII) IMPUL'SNYI PUSKOVOI KANAL "A" REAKTORA NULEVOI MOSHCHNOSTI ANNA. (Pulse Startup Channel "A" of the Zero Power Reactor ANNA). Andzhei Kshytski (Polish Academy of Sciences. Inst. of Nuclear Research, Swierk). Mar. 1963. 11p.

Pulse channels of the startup and power change control of the zero-power reactor ANNA are described. They provide for the measurement of power level and of the reactor period through 5 decades as well as for the signal of exceeding the preset lowest admissible value of period and the minimum level of reactor power (signal of the presence of a neutron source). The main characteristics and description of the circuits of the essential parts of the channel, as a fission chamber, pulse amplifier, linear and logarithmic ratemeter, period meter, and safety trigger circuits, are given. (auth)

45092 (PAN-419/XI) DER GLEICHSTROMMESSKANAL IM KONTROLL-UND SICHERHEITSSYSTEM FUR DEN NULLEISTUNGSREAKTOR MARYLA. (D. C. Measurement Channel for the Control and Safety System of the Critical Assembly Maryla). Jan Podgorski (Polish Academy of Sciences. Inst. of Nuclear Research, Swierk). Mar. 1963. 33p.

A description is given of the d-c compensated ionization chamber control system of the 250-w light water critical assembly Maryla. Technical specifications are given. The system is used primarily for startup safety. (R.E.U.)

45093 (PAN-421/Doz.XI) ANALIZ VOPROSA AVARII REAKTORA VVR-S. (Problems of VVR-S Reactor Accident). Zbignev Baibor and Ksh'shtof Zharnovetsei (Polish Academy of Sciences. Inst. of Nuclear Research, Swierk). Mar. 1963. 20p.

The probability of an accident with the VVR-S reactor and its probable causes are discussed. On the basis of the assumed data concerning the most typical accidents the radiation doses received during the accidents are calculated. Some theoretical calculations and experiments are suggested which would furnish data for additional improvements in the reactor building and equipment and for a decision on a procedure in case of an accident. (auth)

45094 (THAI-AEC-2) PROGRESS REPORT ON REACTOR PHYSICS AND HEALTH PHYSICS. (Thailand. Office of Atomic Energy for Peace, Bangkok). Dec. 1963. 18p.

The kinetics, operation, design, safety, and performance of the Thai Research Reactor-1 (TRR-1) are described. Information is included on: criticality, power calibration, effect of thermal column and beam tubes, temperature coefficient, void coefficient, absorber effectiveness, shielding survey, neutron measurements, health physics, and environment radiation. Fallout monitoring, film badge service, and strontium-90 content in rain water and foods are discussed. (N.W.R.)

45095 (TID-7697) SYMPOSIUM ON PROBLEMS IN IRRADIATION CAPSULE EXPERIMENTS, [HELD AT GERMANTOWN, MARYLAND], OCTOBER 8, 9, AND 10, 1963. William L. R. Rice, ed. (Division of Reactor Development, AEC). Mar. 1964. 658p. (CONF-227)

A total of 65 papers are presented which are arranged into 5 sections dealing with capsule design and operation for nonfissile and fissile materials, dosimetry, heat transfer, instrumentation, temperature control, etc. Separate abstracts were prepared for 56 of the papers. For abstracts of the remaining 9 papers, see NSA: 18: 1297, 2384, 2385, 2386, 2387, 2388, 6911, 11487, and 13336. (D.L.C.)

For abstracts of individual papers see: 43744, 43759, 43774, 43893, 43894, 43895, 43896, 43897, 43940, 43941, 44062, 44934, 45096, 45097, 45098, 45099, 45100, 45101, 45102, 45103, 45104, 45105, 45106, 45107, 45108, 45109, 45110, 45111, 45112, 45113, 45114, 45115, 45116, 45117, 45118, 45119, 45120, 45121, 45122, 45123, 45124, 45125, 45126, 45127, 45128, 45129, 45130, 45131, 45132, 45133, 45134, 45135, 45136, 45137, 45138, and 45139.

45096 (TID-7697(p.1.1.1-22)) CAPSULES FOR SURVEILLANCE OF SOME PLUM BROOK REACTOR STRUCTURAL MATERIALS. Patrick L. Donoughe and Charles L. Younger (National Aeronautics and Space Administration. Lewis Research Center, Cleveland).

Surveillance irradiations are to be carried out on the three materials used in the Plum Brook Reactor (PBR) core: Mallory 1000, 17-7 PH stainless steel, and beryllium. After a brief description of the PBR facility, the design criteria of the capsules for the irradiations are discussed, and the capsules are described. (D.L.C.)

45097 (TID-7697(p.1.6.1-3)) IRRADIATION ON NON-FISSILE MATERIALS IN THE ORR CORE AND POOL FACILITIES. J. R. Weir (Oak Ridge National Lab., Tenn.).

Brief descriptions are given of the P-5 facility outside the core which is used for in-pile stress-rupture and creep experiments and of the B-8 core facility which is used for irradiations at controlled temperatures. The experiments carried out in P-5 are described in some detail. Fast flux monitoring in the facilities are discussed. (D.L.C.)

45098 (TID-7697(p.1.7.1-9)) HIGH-TEMPERATURE GRAPHITE IRRADIATION RIG, SD 486. S. L. Nayler (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

The rig design described is being used for the irradiation of graphite specimens at 1200 to 1300°C in a Mark III fuel element of DIDO reactor. Heat transfer and reactivity absorption calculations are discussed, and instrumentation and safety of the rig are considered. Operational experience with three rigs of this type is discussed briefly. (D.L.C.)

45099 (TID-7697(p.1.9.1-11)) CAPSULES FOR NON-FISSILE IRRADIATIONS. N. H. Hancock (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

A series of rigs were developed for neutron irradiation damage studies of graphite and other non-fissile materials in the Mark III fuel elements in DIDO or PLUTO reactor. The rigs described include Series I, II, III, and IV, which were intended for use at moderate temperatures up to 900°C. (D.L.C.)

45100 (TID-7697(p.2.1.1-7)) DESIGN OF THE EIGHT-BALL IRRADIATION CAPSULE. D. B. Trauger (Oak Ridge National Lab., Tenn.).

A capsule was designed for carrying out the irradiation of several graphite spheres containing coated-particle fuels under similar conditions for comparative purposes. The capsule is being used in the F-1 core position of ORR, and distributions of the thermal neutron flux and temperature across the capsule are given. (D.L.C.)

45101 (TID-7697(p.2.2.1-5)) CAPSULE FOR IRRADIATION OF URANIUM IMPREGNATED GRAPHITE AT

1500°C TO 10% BURNUP. P. J. Peterson, J. A. Leary, and W. J. Maraman (Los Alamos Scientific Lab., N. Mex.).

A capsule was designed for irradiation studies of proposed UHTREX fuel elements in the Omega West Reactor. The design differences between the four successive modifications of the capsule are discussed. The performance of the final capsule design during reactor operation and scrams is described. (D.L.C.)

45102 (TID-7697(p.2.5.1-6)) TRANSIENT TEST CAPSULE DESIGN AND OPERATION. J. H. Field, J. H. Germer, and M. J. McNelly (General Electric Co. Atomic Power Equipment Dept., [San Jose, Calif.]).

A brief description is given of the design philosophy and details of the test capsule used in the irradiation of stainless steel-clad 1.0-in. dia 14-in. long UO_2 in the center position of the TREAT core. The operation and results are described. (D.L.C.)

45103 (TID-7697(p.2.6.1-19)) FISSILE IRRADIATION CAPSULES USED AT A.E.R.E. C. B. T. Braunton and P. A. Clark (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

A considerable variety of capsules have been designed and used at A.E.R.E. to cover the varying needs of fissile irradiation experiments. In all cases the designs had to meet the basic safety requirements of double containment, temperature monitoring, and in those cases where sodium was used, detection of sodium leakage in addition to the experimental requirements. A description is given of a selection of these capsules in which irradiation temperatures up to 1400°C have been achieved over extended periods. (auth)

45104 (TID-7697(p.2.7.1-5)) BOILING WATER IRRADIATION CAPSULE POWER CYCLING TESTS. T. C. Rowland (General Electric Co. Vallecitos Atomic Lab., [San Jose, Calif.]).

A capsule was designed for short-term irradiation testing of fuel specimens in boiling water in the General Electric Test Reactor Trail Cable Facility. Heat flux measurements, oscillation of the capsule, fission product collection, and fuel failure detection are discussed. (D.L.C.)

45105 (TID-7697(p.2.8.1-7)) SODIUM LOGGING CAPSULE DESIGN AND OPERATION. G. L. O'Neill, P. E. Novak, J. E. Hanson, and M. L. Johnson (General Electric Co. Atomic Power Equipment Dept., [San Jose, Calif.]).

Nine test capsules were designed for studying sodium logging phenomena by means of irradiations of UO_2 and PuO_2–UO_2 fuel in the Trail Cable Facility of the General Electric Test Reactor. Design and operating data are tabulated for each of the capsules. (D.L.C.)

45106 (TID-7697(p.2.9.1-19)) IN-PILE FACILITIES TO STUDY FISSION GAS RELEASE IN UO_2 SAMPLES UP TO 2000°C. P. Millies and R. Soulhier (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Grenoble).

A loop facility was designed for studying fission gas release from irradiated UO_2 at very high temperatures in the Melusine reactor. The molybdenum resistor furnace for temperatures up to 1400°C and the high-frequency induction furnace for up to 2000°C are described in some detail. Preliminary results are given for a short irradiation with the induction furnace. (D.L.C.)

45107 (TID-7697(p.2.10.1-9)) RECENT DEVELOPMENTS IN THE DESIGN OF SWEEP-CAPSULE EXPERIMENTAL SYSTEMS FOR DETERMINING FISSION-GAS-RELEASE CHARACTERISTICS. N. E. Miller (Battelle Memorial Inst., Columbus, Ohio).

Sweep-gas systems which were used in evaluating coated fuel particles are described. Several capsules used in the systems are described along with their associated equipment. (D.L.C.)

45108 (TID-7697(p.2.12.1-4)) CAPSULE FOR MEASUREMENT OF UO_2 THERMAL CONDUCTIVITY. D. H. Coplin, M. F. Lyons, and B. Weidenbaum (General Electric Co. Atomic Power Equipment Dept., San Jose, Calif.).

A capsule was designed with means for measuring directly the thermal conductivity of UO_2 during irradiation at very high fuel temperatures. A high temperature sensing device is located in the center of the fuel and consists of a tungsten bulb connected by a tungsten capillary to a pressure transducer. The capsule is being used in the Trail Cable facility of the General Electric Test Reactor. (D.L.C.)

45109 (TID-7697(p.2.13.1-29)) DESIGN, PERFORMANCE, AND REACTOR ENVIRONMENT INFORMATION FOR WAPD TEST CAPSULES. R. C. Daniel (Westinghouse Electric Corp. Bettis Atomic Power Lab., Pittsburgh).

Descriptions are given of the capsules and their operation in experiments in the A31SE facility of the Materials Testing Reactor on the thermal conductivity of UO_2 and UO_2–ZrO_2 fuels. Thermal conductivities of the capsule materials are given, and thermocouple errors are discussed. Graphs of gamma heating and thermal neutron fluxes in the A31SE facility are given. (D.L.C.)

45110 (TID-7697(p.2.14.1-11)) THE SETTLED BED REACTOR IN-PILE CAPSULE. G. P. Pancer (Brookhaven National Lab., Upton, N. Y.). (BNL-7662)

A capsule was designed for irradiation studies of fuels which could be used in the Settled Bed Reactor concept. The capsule is being used in a hole in the Brookhaven Graphite Reactor, and the in-pile assembly is described. Capsule design and operating parameters are tabulated. (D.L.C.)

45111 (TID-7697(p.2.15.1-3)) CAPSULE FOR IRRADIATION OF Pu–1 w/o Al ALLOY. P. J Peterson (Los Alamos Scientific Lab., N. Mex.).

In order to produce short-cooled irradiated Pu for fuel processing experiments, a capsule was designed to contain an 80-g foil of Pu–1 wt % Al alloy for irradiation in the Omega West Reactor. Fabrication of the capsule is described. Cooling, instrumentation, and irradiation performance are discussed briefly. (D.L.C.)

45112 (TID-7697(p.2.16.1-13)) CAPSULE DESIGNS FOR REFRACTORY METAL FUEL AND CERAMIC FUEL TESTING. L. D. Jordan (General Electric Co. Advanced Technology Services, Cincinnati).

A description is given of the capsule designs which were used in the irradiation of BeO-base fuel elements and of refractory metal fuel elements in the ETR, ORR, and LITR. The Instrumentation and in-pile facilities are also described. (D.L.C.)

45113 (TID-7697(p.2.17.1-7)) AN INSTRUMENTED CAPSULE DESIGN FOR ABOVE-2000 F IRRADIATIONS. P. B. Shumaker and J. H. Stang (Battelle Memorial Inst., Columbus, Ohio).

A capsule which was used for irradiation of experi-

mental fuels up to 2600°F, included W–Re thermocouples for monitoring temperatures above 2000°F and Chromel–Alumel thermocouples for secondary monitoring in case of failure of the W–Re thermocouples. The components and assembly of the capsule are described, and the operation of three capsules of this design in MTR is discussed. (D.L.C.)

45114 (TID-7697(p.2.18.1-4)) IN-PILE HYDROGEN PERMEATION EXPERIMENT. T. Golding (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.)

A description is given of the experimental assembly now being irradiated in the ETR to study the in-pile hydrogen permeation through a cladding material. The assembly consists of a coated cladding membrane, a gamma heater, an outer casing, and out-of-pile systems for temperature control and permeation measurement. The design temperature of the coated section of the cladding is 1500°F. (D.L.C.)

45115 (TID-7697(p.2.19.1-7)) THERMIONIC CONVERTER CAPSULE. E. S. Beckjord and T. L. Gregory (General Electric Co. Atomic Power Equipment Dept., [San Jose, Calif.]).

Several thermionic converter capsules have been irradiated successfully in the General Electric Test Reactor. An outline is given of the test objectives, requirements, and hazards, and the capsule design is described. (D.L.C.)

45116 (TID-7697(p.2.20.1-7)) IN-REACTOR FATIGUE TESTING STRAIN CYCLE TEST. M. B. Reynolds (General Electric Co. Vallecitos Atomic Lab., Pleasanton, Calif.).

A slow-cycle strain fatigue test was developed in which gas pressure is used to alternately expand and compress fuel cladding tubes between rigid mandrels. Both out-of-reactor and in-reactor tests were carried out. The in-reactor assembly used in the General Electric Test Reactor is described. (D.L.C.)

45117 (TID-7697(p.2.21.1-5)) CERAMIC FUEL SELF-SERVE FACILITY S/P 485. P. S. J. Ritchie (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

The self-serve facility was designed with means for loading and unloading the ceramic fuel specimens at power and for measuring the specimen heat output. Descriptions are given of the following components: specimen magazine, winch drum magazine and housing, specimen container, and instrumentation. The operation and experimental parameters of the facility are discussed. (D.L.C.)

45118 (TID-7697(p.3.1.1-15)) CAPSULES FOR IN-REACTOR EXPERIMENTS AT CHALK RIVER. V. Fidleris (Atomic Energy of Canada Ltd., Chalk River, Ont.).

A brief survey is presented of the work being done at Chalk River on in-reactor capsules and experiments. The topics include novel capsule designs, capsule heat transfer, flux determination and control, and capsule components and fabrication. (D.L.C.)

45119 (TID-7697(p.3.2.1-12)) IRRADIATING CAPSULE FOR USE IN JRR-2. PART I. S. Hirayama and T. Shoji (Japan Atomic Energy Research Inst., Tokyo).

Some examples are given of irradiation capsule development work carried out in preparation for regular operation of JRR-2, a 10-Mw heavy-water research reactor. The design and properties of the polyethylene capsules for the pneumatic tube and of the aluminum capsules for the vertical thimble are described. The thermal neutron flux in the central vertical thimble (VT-1) can be boosted by sealing light water together with the specimen in the capsule. (D.L.C.)

45120 (TID-7697(p.3.3.1-13)) IRRADIATION CAPSULE FOR USE IN JRR-2. PART II. R. Ueda, T. Fujimura, K. Taketani, S. Ouchi, and M. Ichikawa (Japan Atomic Energy Research Inst., Tokyo).

Progress is summarized of preliminary capsule irradiation tests. These tests include a controlled temperature capsule test with central vertical thimble (VT-1), capsule irradiation experiments with hydrorabbit, and capsule irradiation for fuel dispersions. Drawings are given of the capsules and experimental facilities. (D.L.C.)

45121 (TID-7697(p.3.4.1-17)) UNITED NUCLEAR CORPORATION CONTRIBUTIONS TO THE AEC MEETING ON PROBLEMS IN IRRADIATION CAPSULE EXPERIMENTS. John J. Cihi (United Nuclear Corp. Development Div., White Plains, N. Y.).

A basic capsule design was developed which can accommodate most irradiation samples, both fueled and unfueled. The capsule consists of an inner and outer shell as double containment, liquid metal as heat transfer medium in the inner shell, and the specimen supported in the inner shell with the thermocouples and electric heater. The heat transfer, flux determination and control, components fabrication, and instrumentation of the capsule are discussed. (D.L.C.)

45122 (TID-7697(p.3.5.1-17)) CONTRIBUTION TO AEC MEETING ON PROBLEMS IN IRRADIATION—CAPSULE EXPERIMENTS. W. C. Francis and A. S. Richardson, comps. (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho).

A discussion is presented of some capsule designs which were used in Phillips experiments in MTR and ETR. These include controlled high-temperature capsules for Be, and low-temperature capsules for Be and U–Al fuels. Heat transfer, flux monitoring and control, components and fabrication, and instrumentation are discussed. Variables in capsule experiments are outlined, and a list of MTR-ETR standard practice guides is given. (D.L.C.)

45123 (TID-7697(p.3.6.1-12)) SOME FEATURES OF IRRADIATION CAPSULES USED BY OAK RIDGE NATIONAL LABORATORY, SOLID STATE DIVISION. R. G. Berggren (Oak Ridge National Lab., Tenn.).

The irradiation capsules described include: a water-cooled capsule for irradiation of sheet nickel tension specimens in a partial fuel element in ORR, a capsule for groups of carbon-steel notch-impact specimens in ORR, individually temperature-controlled capsules for iron and steel tensile samples in ORR, tube burst tests in ORR, and a fission spectrum irradiation facility in the Bulk Shielding Reactor. (D.L.C.)

45124 (TID-7697(p.3.7.1-3)) FABRICATION OF INSTRUMENTED IRRADIATION CAPSULES FOR GAS-COOLED REACTOR PROGRAM AT THE OAK RIDGE NATIONAL LABORATORY. E. A. Franco-Ferreira (Oak Ridge National Lab., Tenn.).

In-pile irradiation experiments have been and are still being performed on standard and advanced GCR fuel elements. The fabrication of the capsules is dis-

cussed, with particular emphasis on the thermocouples and their installation. (D.L.C.)

45125 (TID-7697(p.3.8.1-3)) SAFETY REVIEW OF IN-PILE EXPERIMENTS. W. N. Lorentz (General Electric Co. Atomic Power Equipment Dept., Pleasanton, Calif.).

Some information is presented on the methods, techniques, and problems in the safeguards review procedures used with the capsule experiments in the General Electric Test Reactor. Suggestions are given for in-pile experiment design. (D.L.C.)

45126 (TID-7697(p.3.9.1-21)) THE HEAVY WATER COMPONENTS TEST REACTOR AS A CAPSULE IRRADIATION SITE. B. C. Rusche (Du Pont de Nemours (E. I.) & Co. Savannah River Lab., Aiken, S. C.).

A discussion is given of the Heavy Water Components Test Reactor and its facilities for fuel testing. The test conditions which are available are tabulated. After a general description of the reactor, flux determination and control are discussed, and exposure-dependent effects are considered. (D.L.C.)

45127 (TID-7697(p.4.7.1-5)) A REFLUX-TYPE IRRADIATION CAPSULE WITH INTERNAL NUCLEATE BOILING FOR TEMPERATURE CONTROL. J. M. Robertson (United Kingdom Atomic Energy Authority. Industrial Group. Dounreay Experimental Reactor Establishment, Caithness, Scotland).

The problems of measuring and controlling the temperature in capsule fuel irradiation experiments are considered. The cooling of capsules in DIDO reactors by boiling at their outer surfaces is discussed. The advantages of a capsule using internal subcooled nucleate boiling on the specimen surface are outlined, and a proposed design is described. The problem of burnout is considered. (D.L.C.)

45128 (TID-7697(p.4.8.1-4)) SODIUM CAPSULE HEAT TRANSFER. D. Clough (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

Laboratory tests were performed on a modified PLUTO 7V capsule to determine the temperature distribution in the sodium-filled capsule. The results can be used to locate thermocouples in the sodium for measuring the heat output from the specimen. (D.L.C.)

45129 (TID-7697(p.4.10.1-2)) THERMAL DIFFUSION RIG. E. Garrett (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

One possible method of temperature control in fissile irradiations is by means of controlled radial heat transfer through a gas gap, whose thermal conductance can be adjusted by varying the proportions of a binary gas mixture. A laboratory experiment was devised to study possible instability effects in a He–Ne mixture in a simulated 2V irradiation rig. Results indicate no evidence of instability. (D.L.C.)

45130 (TID-7697(p.4.11.1-10)) RECENT OPERATING EXPERIENCE WITH CAPSULES USING VARIABLE GAS MIXTURES FOR TEMPERATURE CONTROL. C. C. Crothers (Argonne National Lab., Ill.).

Several capsules which were or are to be irradiated in the MTR use a flowing N_2–He mixture in an annulus to control the capsule temperature. The equipment used to regulate the flows is described. Results are presented of a test which was conducted to determine the temperature control range of the capsule as a function of He and He–N_2 flow rates. Operating experience with four capsules of this type is summarized. (D.L.C.)

45131 (TID-7697(p.4.12.1-9)) CAPSULE HEAT TRANSFER. R. A. Pugh (General Electric Co. Advanced Technology Services, Cincinnati).

After a brief description of the irradiation program of Nuclear Materials and Propulsion Operation, capsule temperature control by gas mixtures in annuli is discussed. Design considerations are given, and the compensation of the variation in power generation over the capsule length is discussed. Two refractory metal fuel element test capsules, LTFF-5 and MT-115, are described to illustrate the design approach. Calculations of capsule heat transfer by computer codes are considered. (D.L.C.)

45132 (TID-7697(p.4.15.1-7)) A CONTROLLED FLUX CAPSULE IRRADIATION FACILITY. W. K. McCarty (Atomics International. Div. of North American Aviation, Inc., Canoga Park, Calif.).

The NAA-62 irradiation facility concept consists of an annular can which contains BF_3 and a test element within the annular can. The BF_3 pressure can be varied during operation to control the flux at any point in the test element. NAA-62-1 and NAA-62-2 were used to contain UC specimens in ETR, and their operating experience is described. Examples of the effect of BF_3 pressure change on central fuel temperature are given. (D.L.C.)

45133 (TID-7697(p.4.16.1-6)) FLUX AND TEMPERATURE CONTROL DURING IRRADIATION. W. E. Eagan (General Electric Co. Atomic Power Equipment Dept., Pleasanton, Calif.).

The change with the reactor cycle of the neutron flux of the pool positions in the General Electric Test Reactor is discussed. Descriptions are given of the Radially and Vertically Adjustable Facility Tubes (RAFT and VAFT) which were developed for the purpose of keeping the flux and temperature constant at a capsule. A facility tube which has both the features of RAFT and VAFT is also described, and its application in cycling the temperature or flux is considered. Automatic control and coolant control in the facility are described. (D.L.C.)

45134 (TID-7697(p.5.2.1-8)) THE ESTIMATION OF THERMAL-NEUTRON FLUXES IN EXPERIMENTAL ASSEMBLIES. W. R. Hobbs (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

An analogue method for estimating the thermal-neutron flux distribution in experimental assemblies is described. (auth)

45135 (TID-7697(p.5.3.1-8)) THE CALCULATION OF THERMAL FLUXES IN A CAPSULE IN A HETEROGENEOUS REACTOR. J. P. Genthon (France. Commissariat à l'Énergie Atomique. Centre d'Études Nucléaires, Saclay).

A summary is presented of the principles of a method which is used to calculate the real thermal neutron flux in French irradiations in heterogeneous reactors. The method takes into account the heterogeneous nature of the reactor. (D.L.C.)

45136 (TID-7697(p.5.5.1-2)) THERMAL-NEUTRON FLUX OBSERVATIONS IN AN ORR HELIUM-COOLED LOOP. D. B. Trauger (Oak Ridge National Lab., Tenn.).

Plots of heat generation and thermal neutron flux

are given for the clad UO_2 fuel element No. 7B being irradiated in the helium-cooled loop No. 1 in the B-1 position of ORR. The results agree well with these calculated from fuel burnup and flux. (D.L.C.)

45137 (TID-7697(p.5.6.1-9)) NEUTRON DOSIMETRY IN IRRADIATION EXPERIMENTS. S. B. Wright (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

A description is given of some of the techniques used at Harwell to determine the neutron spectrum and dose in experiments in the DIDO and PLUTO reactors. The use of cobalt wires for thermal dose monitoring is discussed, and fast neutron dosimetry is considered. The use of zero-energy reactor for analysis of irradiation experiments is discussed. (D.L.C.)

45138 (TID-7697(p.5.7.1-5)) PHYSICS METHODS FOR EXPERIMENT IRRADIATIONS AT GENERAL ELECTRIC TEST REACTOR. W. N. Lorentz (General Electric Co. Atomic Power Equipment Dept., Pleasanton, Calif.).

The problem of determining the effective neutron flux in a test reactor is to determine the unperturbed neutron flux in the absence of the experiment and to determine the perturbation of the flux by the experiment. The calculation of the unperturbed flux and local perturbation in GETR is described, and the agreement between predicted and observed results is discussed. (D.L.C.)

45139 (TID-7697(p.5.8.1-4)) THE HIGH FLUX, HIGH TEMPERATURE ION CHAMBER TEST RIGS. H. Bowes (United Kingdom Atomic Energy Authority. Research Group. Atomic Energy Research Establishment, Harwell, Berks, England).

A program of accelerated life tests of ion chambers was conducted which used eight test rigs in the PLUTO reactor. The test rigs are described, and flux and temperature distributions through the rigs are given. (D.L.C.)

45140 A NEW RECORD: THE REACTOR SILOE REACHES A POWER OF 15 MEGAWATTS. Chim. Ind. (Paris), 91: 120(Feb. 1964).

Siloé research reactor, which is of the open-core swimming-pool type, and is run by the C.E.N. at Grenoble, was designed for an output of 10 megawatts, and it has already been operating at this power since it was commissioned on 22nd June 1963. This was already a world record since no open-core swimming-pool reactor had exceeded a power of 5 Mw. Until now, the power of this type of reactor was limited by the surface radioactivity of the various elements in the water, in particular sodium-24. This problem was solved for Siloé by establishing a hot surface layer. As a result, from 5th-9th November, Siloé operated without difficulty at a power of 15 Mw with handling operations, and tests without handling were stepped up as far as 20 Mw. (auth)

45141 OPERATION AND CONTROL OF THE RAPSODIE REACTOR. J. Uberschlag (Centre d'Etudes Nucleaires, Saclay, France), A. Chapelot, R. Lelait, R. Abdon, A. Jeannot, and J. Ladet. Onde Elec., 44: 829-42(July-Aug. 1964). (In French)

A brief introduction on the interest and some special features of fast breeder reactors is given. The installation and exploitation of these reactors are discussed from the viewpoint of their control. The organization of the control, operation, and data logging is defined. Some control-operational circuits, relatively well defined at the present stage of construction, are described. (tr-auth)

45142 CONSTRUCTION OF A LOW-TEMPERATURE IRRADIATION APPARATUS AT THE MUNICH RESEARCH REACTOR. Robert Doll (Bayerische Akademie der Wissenschaften, Munich), Holger Meissner, Nikolaus Riehl, Werner Schilling, and Fritz Schemissner. Z. Angew. Phys., 17: 321-9(July 1964). (In German)

The construction of a low-temperature irradiation facility at the Munich Research Reactor was described. It is possible with this installation to perform irradiations in the reactor core at 4.7°K in a flux of 10^{13} fast neutrons/cm^2 sec; and to investigate lattice defects formed in the irradiation. A He cooling installation yielding a coolant output of about 170 w, for cooling the samples and the irradiation cryostats, was described. The installation of the irradiation apparatus in the reactor and the safety at low temperature were discussed. (tr-auth)

45143 IMPROVEMENTS RELATING TO LIQUID MODERATED HETEROGENEOUS REACTORS. (to United Kingdom Atomic Energy Authority). French Patent 1,328,235. Apr. 16, 1963. Priority date July 10, 1961, Great Britain.

A core structure, particularly suitable for zero-power reactors and adapted for replacements and rearrangements of fuel elements, was designed with means for placing a series of frames parallel to each other within the reactor tank. Each of the flat frames is adapted to support a series of fuel elements. The tank has a cover with a series of parallel slits and is adapted to move so that these slits may be brought into line with frames to be removed from the reactor or with places for receiving such frames. Each of these frames has lateral ears with which it rests on right-angle pieces fixed on opposite walls of the reactor tank. Guiding rods are passed through the ears and parts of the right angles surrounding the ears and are lowered through a slit in the cover. A square portion of the rod cooperates with a square hole of a latch pivotally mounted on the right angle and provided with a lateral finger, which can lock the frame. By rotation of the guiding rods the frame may be locked or unlocked from the right-angle pieces. (IIB)

45144 IMPROVEMENTS RELATING TO NEUTRON SHIELDS FOR LIQUID MODERATED EXPERIMENTAL REACTORS WITH A SOLID REFLECTOR. (to Communauté Européenne de l'Énergie Atomique (EURATOM)). French Patent 1,330,513. May 13, 1963. Priority date Sept. 15, 1961, Belgium.

In experimental reactors it may be necessary to study the behavior of the core without the reflector working. For this purpose neutron absorbant skirts were adapted to be lowered into an annular interstice between the core tank and the reflector. Such a rigid skirt is extended by a second skirt adapted to be wound up in the manner of a Venetian blind. This shutter may consist of several independent slatted sections surrounding the reactor tank. The rigid skirt and the slatted shutters are joined together by conventional means such as electromagnets, hooks, etc. (IIB)

45145 NEW IRRADIATION RIG. (to Commissariat a l'Energie Atomique). French Patent 1,336,223. July 22, 1963. Filed June 29, 1962.

An irradiation rig was designed, which consists of a tubular support formed by two vertical sections that are not in alignment. The lower end of the upper section is connected with the upper end of the lower section by a third horizontal section. The rig has in its lowermost section the irradiation chamber and is adapted to be placed in a swimming pool reactor. The horizontal and the upper-

most sections have connection lines for measuring apparatus, the measuring heads of which are disposed within the irradiation chamber. The horizontal section may have a case-like shape, the upper portion of which is formed by a fluid-tight cover and has a flat fitting with the terminals of the connections to the measuring instruments. It is adapted to receive coupler plugs forming terminals for the connections to the measuring heads. (IIB)

45146 ADVANCED TEST REACTOR. Deslendo R. deBoisblanc and Byron H. Leonard, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,149,044. Sept. 15, 1964.

A thermal nuclear reactor, containing a moderator with a core consisting of a plurality of fuel elements arranged in multileaf configuration in which the fuel elements in each leaf are arranged in a smooth curve forming more than a 180° segment of a circle and the leaves are joined by fuel elements forming a segment of a circle and including a pressure tube forming an experimental loop centered in each leaf of the core, is described. (AEC)

WASTE DISPOSAL AND PROCESSING

45147 (HW-82771(Pt.1)) RECOVERY OF ALUMINUM NITRATE NONAHYDRATE FROM REDOX ACID WASTE. PART 1: COMPUTER STUDY. W. L. Godfrey and R. D. Benham (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 1964. Contract AT(45-1)-1350. 18p.

A counter-current crystallization process was developed and demonstrated on the laboratory scale for recovering aluminum nitrate nonahydrate from Redox waste. Equations describing this process were developed and simulated on a conventional analog computer (a Beckman EASE 1132) and an iterative analog computer (a Beckman EASE 2133). The results from both computers checked satisfactorily with laboratory data. Slow "control-relay" operating speeds associated with the EASE 1132 computer caused timing problems; as a result, reproducible solutions were obtained only by using excessively long computer cycle times. The speed of the control relays on the EASE 2133 computer allowed solution of the problem about 600 times faster. (auth)

45148 (HW-83320) RESEARCH AND DEVELOPMENT ACTIVITIES, FIXATION OF RADIOACTIVE RESIDUES QUARTERLY PROGRESS REPORT, APRIL–JUNE 1964. A. M. Platt, ed. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). July 1964. Contract AT(45-1)-1350. 30p.

Membrane filters were shown to be efficient Ru samplers during a spray calcination run with full-level Purex waste. Visual observation of a four-month-old radioactive phosphate glass revealed several small cracks. Results of glass formulation studies indicate that the phosphate is almost universally lost during drying and melting. Assembling and testing of equipment for a hot cell glass experiment is nearly completed. The cold semiworks 18-in. calciner and continuous melter were successfully operated as a composite unit. Laboratory studies of the CSREX process under gamma irradiation show a two-fold decrease in Cs distribution ratio. Continued computer studies to ascertain the most important factors in removal of heat from underground storage tanks have further delineated the effects of cake and soil thermal conductivity and cake thickness. Purex acid and alkaline condensates were treated by an electrodeionization technique to evaluate Ru removal. Ru decontamination factors of 50 and 15 were obtained for the acid and alkaline condensates respectively. Linde AW-500 zeolite was shown to yield minimum fines when mixed vigorously with water. At least three types of cation sites were observed to be present on Type X zeolites. (auth)

45149 (HW-SA-3575) DISCUSSION OF RADIOACTIVE WASTE MANAGEMENT PRACTICES. G. E. Backman (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). June 5, 1964. Contract AT(45-1)-1350. 18p. (CONF-708-1)

From Lecture on Radioactive Waste Management, Portland, Ore., June 1964.

The main consideration in radioactive waste management is to prevent undue radiation exposure as economically as possible. The two disposal concepts of concentration-containment and dilution-dispersion are discussed for gaseous, liquid, and solid wastes, respectively. (D.L.C.)

45150 (IDO-14631) PNEUMATIC ATOMIZING NOZZLES IN FLUIDIZED-BED CALCINING. PART II. PROCESS TESTS. B. M. Legler and B. P. Brown (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho). July 1964. Contract AT(10-1)-205. 31p.

Results of both pilot plant and plant process tests showed that conventional pneumatic atomizing nozzles constructed of Types 347 or 440-C stainless steel provided satisfactory feed introduction to fluidized bed calciners when the nozzle spray zone was adequately submerged in the fluidized material. When feeding aluminum nitrate solution to a calciner at a given rate, variation of the nozzle air rate was effective in controlling particle size within the fluidized bed without the use of other attrition devices. Erosion of feed nozzles, indicated to be severe in early pilot plant tests, was negligible in the plant-scale calciner at the Waste Calcining Facility. Where erosion was a problem, boron carbide provided complete erosion resistance, but the inherent brittleness of boron carbide often resulted in fracture during installation or disassembly. Temperature perturbations due to the presence of the nozzle spray zone in the fluidized bed presented no serious difficulties, and caking of the bed material was negligible over a wide range of operating conditions. Generation of fines attributable to nozzle effects, although greater than expected, was within acceptable limits. A nozzle feed rate control system employing electromagnetic flowmeters significantly improved the performance of the nozzles in the Waste Calcining Facility. Although all testing in this study involved non-radioactive simulated waste solutions, the ultimate application is for high-level radioactive waste solutions. (auth)

45151 (TID-7699) REPORT OF THE FOURTH WORKING MEETING ON CALCINATION AND/OR FIXATION OF HIGH LEVEL WASTES IN STABLE, SOLID MEDIA AT BROOKHAVEN NATIONAL LABORATORY, UPTON, NEW YORK, FEBRUARY 11-12, 1964. (Division of Reaction Development, AEC). 104p.

Four papers are included which discuss the status of the following processes for solidification of radioactive wastes: fluidized-bed calcination, glass fixation, pot calcination, and spray solidification. Separate abstracts were prepared for three of the papers; the other paper was abstracted previously as NSA, 18: 26978. (D.L.C.)

For abstracts of individual papers see: 45152, 45153, and 45154.

45152 (TID-7699(p.1-23)) STATUS OF FLUIDIZED BED CALCINATION DEVELOPMENT AND PLANT OPERATION AT ICPP. J. A. Buckham, G. E. Lohse, and A. L. Ayers (Phillips Petroleum Co. Atomic Energy Div., Idaho Falls, Idaho).

A description is given of the process and equipment development for the Waste Calcining Facility. The final cold testing and initial radioactive operation of the facility are discussed. The properties of the product are listed. Off-gas cleanup and safety analysis are discussed. Volatility tests and preparation of glass from calcined alumina are considered. The future prospects and use of the facility are discussed briefly. (D.L.C.)

45153 (TID-7699(p.24-35)) STATUS OF PHOSPHATE GLASS PROCESS FOR FIXATION OF HIGH-LEVEL

RADIOACTIVE WASTE. L. C. Emma, E. J. Tuthill, and G. G Weth (Brookhaven National Lab., Upton, N. Y.).

Several extended runs of a pilot plant for the phosphate glass fixation of wastes were carried out. Operating data and chemical data from the runs are shown. The break in the freeze valve tube which occurred during one run is discussed. Instrumentation of the pilot plant is discussed. Bench-scale equipment to be used in small hot-cell experiments on Purex waste at Hanford, and the experiments themselves, are described. Results are given of studies on the corrosion of Pt, Pt–Rh, Pt–Au, and Pt–Ir by phosphate glass for 3000 hr at 1200°C. (D.L.C.)

45154 (TID-7699(p.73-95)) STATUS OF RESEARCH, DEVELOPMENT, AND DEMONSTRATION PROGRAMS ON SOLIDIFICATION OF RADIOACTIVE WASTES. A. M. Platt, R. T. Allemann, C. R. Cooley, J. D. Kaser, J. D. Moore, F. P. Roberts, K. J. Schneider, and U. L. Upson (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.).

A summary is presented of research and development work carried out on waste solidification during the period Sept. 1962 to March 1964. The work includes: small-scale spray and pot calcination of high-level radioactive wastes, large-scale spray solidification of simulated wastes, and development of an engineering-scale prototype for demonstration of three promising solidification processes (pot calcination, spray solidification, and phosphate glass solidification). (D.L.C.)

45155 (TID-20980) PART I. INORGANIC SORBENTS. B. L. Baker and T. H. Wilson. PART II. SOIL PERCOLATION STUDIES. E. R. Conway. Progress Report No. 9. (South Carolina. Univ., Columbia). July 30, 1964. Contract AT(38-1)-147. 90p.

Research work is reported on inorganic sorbents for the removal of radioactive ions from waste streams. A brief review of previous work is presented along with descriptions of investigations that were performed during the period. Results of experiments showed that hydrous metallic oxides of Fe(III), Co(III), Al and Sn(IV) sorbed Sr ions by the mechanism of adding one equivalent of hydroxyl ion per equivalent of Sr. These materials sorbed little or no Cs. Aluminum silicate gel—sodium form with ratio $Al_2O_3 \cdot 10SiO_2$ was found to be somewhat selective for Cs in the presence of Na, K, NH_4, and Sr ions. The physical characteristics are fair and make it suitable for column packing. Several cycles of sorption and elution using columns were made with good results. The gel has a capacity for Cs of approximately 1.5 to 1.6 Meq/gram. A systematic study was begun to develop other inorganic materials as sorbents. Ferric and zirconium arsenates were examined. Both show better than 1-Meq/gram capacities for Sr in acid media. Zirconium arsenate appears to be very stable in HNO_3 solutions. Work with the permeameter described in a previous report was continued in an effort to evaluate the usefulness of a suggested equation for flow of water through packed beds. Runs were made with Savannah River Plant soil, with spherical glass beads, with Raschig rings, and with Berl saddles. The blank correction for the permeameter was re-evaluated and was checked by calculations. Two new bed lengths were added to those available for the permeameter and were used for the beds tested. Shape factors for all packings other than the soil were determined from geometric measurements for comparison with those found from hydraulic measurements made with the permeameter. The data for runs reported previously were re-examined and recalculated in the light of newly determined soil densities and a slightly new graphical method of evaluating the data of some of the runs. The recalculated results are somewhat more consistent than those reported earlier. The results show that the form of an equation suggested by Ergun gives fair accuracy when used with soil beds of the type tested but that it does have some error except when used for beds of spheres. The agreement found between beds of spheres and the Ergun equation suggests that the permeameter gives accurate and reliable results. For the soil tested, the average value of ϕ_e was found to be 0.695 for particles coarser than 45 mesh; the average value found for b_e was 2.56 (compared with 1.75 suggested by Ergun). The results of the work with Raschig rings and Berl saddles suggest that Ergun's value of the constant a of 150 might also be somewhat in error for non-spheres. Further work should be done to find how the constants a and b vary with particle shape. Other evidence was also found which suggests that some phenomenon occurs in packed beds that is not accounted for in the Ergun equation: the ϕ_e and b_e values predicted for blends did not agree precisely with those found experimentally and the working plots of H/w versus w were found to arch slightly for the coarser non-spherical particles. Further work should be done to discover the nature of this phenomenon and to find how it should be treated in the Ergun equation. (auth)

45156 (UJV-1109/64) OPYT PO EKSPLUATATSII USTANOVOK PO OBESVREZHIVANIYU RADIOAKTIVNYKH OTKHODOV V IYAI V RZHEZHI. (Operation of Waste Decontamination Installations Constructed by the Institute of Nuclear Research in Rzhezhi, Czechoslovakia). I. Zaruba and I. Napravnik (Ceskoslovenska Akademie Ved. Ustav Jaderneho Vyzkumu, Rez). [nd]. 7p.

Descriptions are given of two installations for liquid waste decontamination by evaporation that have a capacity of 125 to 140 kg/hr at 80°C and yield a 100-fold volume reduction. The mean activity of treated material was 10^{-6} C/l, mean dry residue 1.5 g/l, with pH from 2.5 to 4.5. A layer and improved device built in 1961 increased capacity to 8 m^3/hr. Since 1962 the installation has processed 570 m^3 of waste with activities from 10^{-4} to 10^{-8} C/l and dry residue 0.5 to 7 g/l. (R.V.J.)

45157 WASTE MANAGEMENT: TECHNOLOGICAL ADVANCES AND ATTITUDES OF SAFETY. W. G. Belter, D. E. Ferguson, and F. L. Culler. Nucl. News, 7: No. 10, 94-7(Oct. 1964).

A summary is given of the Geneva Conference papers on waste management including the technological advances that were reported and the changes in safety attitudes that have occurred. (C.E.S.)

45158 SAFETY PROBLEMS ASSOCIATED WITH THE DISPOSAL OF RADIOACTIVE WASTE. Walton A. Rodger. Nucl. Safety, 5: 287-302(1964).

A review of waste problems in the nuclear industry is presented. Discussions are included concerning areas of potential hazard, methods of dealing with hazards, and effects of accidents on the waste disposal experience. (J.R.D.)

45159 METHOD OF DEHYDRATING AND INSOLUBILIZING AN AQUEOUS NUCLEAR REACTOR WASTE SOLUTION. W. E. Winsche and M. W. Davis, Jr. (to U. S. Atomic Energy Commission). U. S. Patent 3,152,984. Oct. 13, 1964.

A method for disposing of radioactive waste is described, which is inexpensive, convenient, and safe. The waste solution is mixed with sulfur, the mixture heated to a temperature sufficient to dehydrate it and drive off volatile components and decomposition products, then it is heated to a higher temperature sufficient to insolubilize the other waste components, and finally the residual mixture is

solidified. The radioactive waste material is thereby encapsulated within a solid water-repellent matrix, which is virtually immune to degradation by the radiation of the waste material. (AEC)

45160 STRONTIUM RECOVERY PROCESS. George Jansen, Jr., Gerald L. Richardson, Allison M. Platt, and Lane A. Bray (to U. S. Atomic Energy Commission). U. S. Patent 3,154,500. Oct. 27, 1964.

A process was developed for recovering strontium from aqueous waste solutions by adding ethylenediaminetetraacetic acid, extracting into di-2-ethylhexylphosphoric acid, stripping the di-2-ethylhexylphosphoric acid with an aqueous citric acid solution, adsorbing on a cation exchange resin, washing the resin with a complexing agent for elution of co-adsorbed rare earths, zirconium, niobium, iron, lead, and ruthenium, and desorbing the strontium with an aqueous sodium nitrate solution. (AEC)

GENERAL AND MISCELLANEOUS

45161 (BNL-7328) WIND GUST SPECTRA. Irving A. Singer (Brookhaven National Lab., Upton, N. Y.). [1962]. Contract AT-30-2-GEN-16. 35p. (CONF-743-1)

From Conference on Large Steerable Antennas–Climatological and Aerodynamical Considerations, New York Academy of Sciences, New York, Sept. 1964.

The structure of turbulent fluctuations is important in the design of such structures as missiles, high-speed aircraft, and large steerable antennas. A review is conducted of some studies of atmospheric turbulence in an effort to correlate and summarize the results for practical application. These studies were made at 75, 150, and 300 feet above fairly smooth terrain. The results show that: intensity of turbulence is constant with height; local isotropy exists at wavelengths <100 m; horizontal isotropy is continuous up to wavelengths of 500 m; cross spectra are essentially zero; and cross correlation coefficient of similar wind component is a function of the ratio of heights. Recommendations are made for future studies. (D.L.C.)

45162 (CONF-707-1) INDICES OF THYROID GLAND FUNCTION IN CALVES. C. B. Hendrich and C. W. Turner (Missouri. Univ., Columbia). [1964]. Contract AT(11-1)-301. 4p.

From American Dairy Science Association 59th Annual Meeting, Tucson, Ariz., June 1964.

The effect of environmental temperature on thyroid gland function was determined in calves. The rate of release of thyroidal-^{131}I, the disappearance rate of thyroxine-^{131}I from the blood, and daily thyronine excretion rates were determined during the spring, fall, winter, and late fall in calves that ranged in age from 3 weeks to 3.5 months at the beginning of the series of experiments and 7 to 10 months of age in the fall. No significant effects of environmental temperature on thyroid function were observed. (C.H.)

45163 (CONF-707-2) MAMMARY GLAND GROWTH OF VIRGIN DAIRY HEIFERS MEASURED BY MILK PRODUCTION. G. A. Hindery and C. W. Turner (Missouri. Univ., Columbia). [1964]. Contract AT(11-1)-301. 3p.

From American Dairy Science Association 59th Annual Meeting, Tucson, Ariz., June 1964.

Preliminary studies on fifteen dairy heifers showed that with increasing numbers of recurring estrus cycles and subcutaneous administration of estrogen alone copious milk secretion may be obtained. When these same heifers received decreasing levels of progesterone and increasing levels of estrogen their milk production was substantially increased. Twelve virgin dairy heifers of three breeds varying from 7 months to three years injected daily with 0.3 mg estradiol benzoate (E.B.) per 100 lbs. body weight for 14 days to initiate milk production showed enlargement of teats and udder within 24 to 48 hours and a marked stimulation of milk. After 45 days in milk a second stimulation of E.B. for a 7 day period further increases the milk yield, depending on the age and number of recurring estrus cycles prior to E.B. stimulation, by a mean of 138.7%. Further increases in milk production were obtained after the heifers leveled off in milk yield by daily injections of L-thyroxine at 125% of their maximum normal secretion rate. The mean percentage increase was 20.1. Additional experiments are under way to further establish the effects of estradiol benzoate when administered alone to increase milk production. (auth)

45164 (CONF-722-1) THYROXINE SECRETION RATES OF THE OPOSSUM (DIDELPHIS VIRGINIANUS). T. R. Bauman and C. W. Turner (Missouri. Univ., Columbia). [1963]. Contract AT(11-1)-301. 5p.

From American Society of Zoologists Southern Regional Meeting, Houston, Tex., Oct. 1963.

Thyroxine secretion rates (TSR) were determined on 20 adult and 37 juvenile opossums, a total of 57 animals with 111 observations. The mean TSR for juveniles during all seasons of the year was 2.65 μg/100 gbw, and the mean TSR for adults was 1.72 μg/100 gbw. When the TSR's of the adult animals were compiled by season, it was found that in the spring the mean TSR was 1.94 μg/100 gbw (16 observations), in the summer it was 1.19 μg/100 gbw (4 observations), the fall values were 1.33 μg/100 gbw (13 observations) and in the winter it was 1.92 μg/100 gbw (18 observations). The juvenile animals had a mean TSR in the summer of 2.48 μg/100 gbw (40 observations), in the fall the mean was 2.04 μg/100 gbw (17 observations) and in the winter it rose to 3.75 μg/100 gbw (3 observations). The TSR's of the adults of all seasons, divided into male and female groups ran nearly the same, that is, males 1.70 μg/100 gbw (29 observations) and females 1.74 μg/100 gbw (22 observations). If the juveniles were separated by sex, it was found that the mean TSR of the males was 2.56 μg/100 gbw (29 observations) and of the females was 2.72 μg/100 gbw (31 observations). A chart with comparison of TSR's of many species is included. (auth)

45165 (COO-1148-88) ELECTROOXIDATION OF TETRAPHENYLBORATE ION AT THE PYROLYTIC GRAPHITE ELECTRODE. W. Richard Turner and Philip J. Elving (Michigan. Univ., Ann Arbor). July 15, 1964. Contract AT(11-1)-1148. 24p.

Tetraphenylborate ion is oxidized at the stationary pyrolytic graphite electrode in aqueous solution to produce two voltammetric waves. The first wave, which occurs as a well-defined peak ($E_{p/2}$ = 0.216 v vs saturated sodium chloride calomel electrode) results from a 2-electron, pH-independent process which produces diphenylborinic acid and biphenyl: $B(C_6H_5)_4^- \rightarrow B(C_6H_5)_2^+ + (C_6H_5)_2 + 2e^-$ and $B(C_6H_5)_2^+ + H_2O \rightarrow B(C_6H_5)_2OH + H^+$. The second wave, which is less well-defined, represents a 2-electron process, which involves the oxidation of diphenylborinic acid: $B(C_6H_5)_2OH + 2H_2O \rightarrow B(OH)_3 + (C_6H_5)_2 + 2H^+ + 2e^-$. The latter process is linearly pH-dependent: $E_{p/2} = 0.92 - 0.057$ pH. The slope of −0.057 indicates that one hydrogen ion is produced for each electron liberated in the oxidation. (auth)

45166 (COO-1148-89) ELECTROOXIDATION OF THE TETRAPHENYLBORATE ION IN AQUEOUS SOLUTION AT THE PLATINUM DISK ELECTRODE. W. Richard Turner and Philip J. Elving (Michigan. Univ., Ann Arbor). Sept. 8, 1964. Contract AT(11-1)-1148. 6p.

Despite earlier claims to the contrary, it is possible to obtain voltammetric waves for the electrochemical oxidation of tetraphenylborate at the platinum electrode in aqueous solution. Two waves are obtained in acid solution, the first one of which is well-defined. These waves blend into one when the electrode is rotated. In alkaline solution (pH 12) the electrolytic discharge of the background electrolyte alters the surface of the platinum electrode to such an extent that the tetraphenylborate oxidation wave is shifted to a potential greater than that required for the background discharge. (auth)

45167 (CU-2663-11) SOME TOW TANK CALIBRATIONS OF THE SAVONIUS ROTOR. Robert Sexton (Columbia Univ., Palisades, N. Y. Lamont Geological Observatory). Sept. 1964. Contract AT(30-1)-2663. 77p.

Calibrations of several types of ocean-current measuring meters using a Savonius rotor were carried out for use with the data gathered on the CONRAD Cruise #7. A tow tank with a rotating arm was used in the calibrations. The results confirm the belief that average curves for one meter design can be prepared from the calibration of a significant number of meters. However, separate curves must be drawn for the vertical position and for representative angles of positive and negative tilt. The curves are accurate to 0.005 kt. in the threshold region and above the threshold to 0.03 kt. The threshold of the rotors is about 0.1 kt. The effects of vibrations on the rotors were studied. (D.L.C.)

45168 (EMRL-24) COMBINED STRESS CREEP EXPERIMENTS ON A NON-LINEAR VISCOELASTIC MATERIAL TO DETERMINE THE KERNEL FUNCTIONS FOR A MULTIPLE INTEGRAL REPRESENTATION OF CREEP. Technical Report No. 1. K. Onaran and W. N. Findley (Brown Univ., Providence. Engineering Materials Research Lab.). June 1964. Univ. of California, Lawrence Radiation Lab., Livermore. Contract [W-7405-eng-48]. 51p. (UCRL-13124)

A multiple integral functional relationship has been employed as a constitutive equation for non-linear creep of viscoelastic material under combined stress. The kernel functions of this representation for first, second, and third order stress terms have been determined from tests on a single tubular specimen of polyvinyl chloride copolymer. Tests needed to determine kernel functions adequate to describe multiaxial creep under constant stress were found to be three pure tension tests at different stress levels, three pure torsion tests at different stress levels, and two combined tension-torsion tests. Experiments include twenty tests under various combinations of tension and torsion on the same specimen. The use of only one specimen was made possible by the fact that following two hours of creep the recovery in 4 days was almost complete. Agreement between the multiple integral representation and experimental results was very satisfactory. Agreement with a hyperbolic sine representation of stress dependence was less satisfactory owing in part to the fact that the synergistic effect of tension plus torsion in the non-linear range was not accounted for. (auth)

45169 (HW-SA-3697) UNDERSTANDING ULTRASONIC WAVE PROPAGATION IN NONDESTRUCTIVE TESTING. C. E. Fitch, Jr. (General Electric Co. Hanford Atomic Products Operation, Richland, Wash.). Aug. 31, 1964. Contract AT(45-1)-1350. 43p. (CONF-748-1)

From Symposium on Physics and Nondestructive Testing, Dayton, Ohio, Sept.-Oct. 1964.

Studies were undertaken to determine how the presence of attenuation and boundry waves generated at critical angles effect the propagation of ultrasonic waves. The analytical and experimental wave behavior associated with a liquid-liquid interface was studied in detail. Experiments and discussions include some analogous situations for liquid-solid interfaces. Schlieren photographs of unusual boundary wave effects and Lamb-wave propagation are also included. (auth)

45170 (IS-1018) THERMAL DIFFUSIVITY OF PLATINUM FROM 300 TO 1300°K. J. J. Martin and P. H. Sidles (Ames Lab., Ames, Iowa). Oct. 13, 1964. Contract W-7405-eng-82. 8p. (CONF-764-1)

From Thermal Conductivity Conference, San Francisco, Oct. 1964.

The thermal diffusivity of commercial and of high purity platinum has been measured from room temperature to 1200°K. Thermal conductivity values have been calculated from these results and compared with the measured thermal conductivity values reported by three other investigators. This comparison indicates that platinum, at elevated temperatures, exhibits the unusual characteristics of a progressive increase in thermal conductivity with decreasing sample purity. In spite of this unusual behavior, the thermal conductivity of platinum may be stable enough to serve as a thermal conductivity standard with an uncertainty of about ±5%. (auth)

45171 (LADC-5611) LOS ALAMOS STUDIES OF SHOCK INITIATION OF EXPLOSIVES. W. C. Davis (Los Alamos Scientific Lab., N. Mex.). [1963]. Contract W-7405-eng-36. 5p.

A review is presented of work done at Los Alamos on the shock initiation of explosives in times less than 10^{-5} sec. Large plane shock waves were used in studies of homogeneous and inhomogeneous explosives. The results with homogeneous explosives show that the mechanism is simple shock heating with subsequent chemical reaction. The opaqueness which occurs in some explosives a short time after shock is discussed. The initiation of inhomogeneous explosives is more complicated than that of homogeneous explosives. (D.L.C.)

45172 (MLM-1190) HELIUM-3: AN ANNOTATED BIBLIOGRAPHY. C. F. Eck, K. J. Kaminski, and W. A. Wakat, comps. — W. J. Haubach, ed. (Mound Lab., Miamisburg, Ohio). Sept. 28, 1964. Contract AT-33-1-GEN-53. 452p.

A total of 1486 abstracts are presented of articles which mention helium-3 and which were published before Jan. 1, 1963. The abstracts are arranged chronologically by the year of publication. Author and subject indexes are included. A brief summary is presented of the major properties of helium-3 and helium-4. (D.L.C.)

45173 (MLM-1203) MOUND LABORATORY PROGRESS REPORT FOR MAY 1964. J. F. Eichelberger, G. R. Grove, and L. V. Jones (Mound Lab., Miamisburg, Ohio). May 29, 1964. Contract AT(33-1)-Gen-53. 21p.

It is noted that in determining the total neutron emission rate of a source whose emission is not isotropic, it is necessary to integrate the neutron flux over 4π geometry. The accuracy of Gauss' quadrature formula for evaluating this integral was determined. The basic counting integral was evaluated in three different ways, one of which was a comparison to Simpson's Rule. Gauss' method was determined to be accurate and less time-consuming than Simpson's Rule. A comparison was made between the measured neutron yields of PoBe sources recently fabricated at Mound Laboratory and values previously reported in the literature. The best values were obtained from recently fabricated sources, which had a maximum yield of $(70 \pm 2) \times 10^{-6}$ neutrons/Po-alpha-particle. Literature values ranged from 50×10^{-6} to $(80 \pm 16) \times 10^{-6}$ neutrons/Po-alpha-particle. The length of the charcoal trap used to purify ^3He feed gas prior to final enrichment by thermal diffusion was increased from 28 to 48 ft. This trap reduced the tritium

content of the gas to 6.14×10^{-7} mole %. The Weber-Schmidt equation was investigated to determine the effect of the sensing tube radius on the thermomolecular pressure gradient in He vapor pressure thermometers. With a tube radius of approximately 0.025 cm, a change in radius of 0.01 cm can produce a maximum pressure deviation of approximately 80 microns of Hg. Since this deviation could represent as much as 50% of the total thermomolecular pressure gradient, it was necessary to accurately determine the radius of the $1/32$-in. tube, thus eliminating a possible variable from the experimental work. The radius of the tube was 0.0249 ± 0.0006 cm. The ±0.0006-cm deviation can produce a maximum error of only about 2.5% in the data. Measurements of the difference in thermomolecular pressures in this $1/32$-in.-tube and a $1/4$-in.-tube were made using both equilibrium and nonequilibrium ^{4}He. The measurements agreed with earlier data obtained at Mound Laboratory; however, there is an unexplained discrepancy between these data and values determined by the Weber-Schmidt equation. Five experiments were performed in which ^{3}He in dilute ^{3}He/^{4}He mixtures was enriched from 0.09% to 2.05% by filtering superfluid ^{4}He through jeweler's rouge. A simple heat-flush technique was developed for preserving the separation at the end of the experiment. Thirty-three days after the Ar thermal diffusion system was started up with natural abundance feed gas the fourth stage top concentration was 99.55 mole % ^{35}Ar. The eight-column, five-stage, swing cascade thermal diffusion system was operated at 170 torr and at a wire temperature of 850°C to enrich ^{136}Xe. At the bottom of the last stage the ^{136}Xe concentration was 81.71%. A light fraction from a previous Xe separation contained 2.66% Kr impurity. The Kr impurity in part of the Xe product was reduced to 0.30%, and the Xe concentration was increased to 20.88% in a two-column cascade thermal diffusion system. The 2.66% Kr impurity in part of the previously mentioned Xe was separated by gas chromatography. After this purification no Kr could be detected in the product by chromatography. A 24-column thermal diffusion system with an active length of 12 ft is being constructed. A prototype column was used for static separation of a mixture of Ar isotopes at 2,500 and 3,500 torr. At the bottom of the system the ^{40}Ar concentration was greater than 99%. Ne isotopes were experimentally separated by thermal diffusion using alternating current for heating the center wire; an Hg well was used at the bottom of the column. No wire vibration was visible at a wire temperature of 800°C. Enriched CH_4 was used as feed for the 11-column, 9-stage thermal diffusion cascade. Approximately 18 g ^{13}C was accumulated in the form of CH_4. Isotopic purity of this product ranged from 90 to 94% ^{13}C in total C. The chemical purity of the product CH_4 was 95 to 98% with N_2 as the major impurity. In order to supply ^{13}C in the form of $BaCo_3$, a system was built to make the conversion from CH_4. Enriched CH_4 was burned in O_2 over a heated Pt filament. The resulting CO_2 was absorbed in a $Ba(OH)_2$ solution, and $BaCo_3$ was precipitated. Test runs with natural abundance CH_4 showed complete recovery of the C as $BaCo_3$. Flexane-30, a two-part polyurethane potting material was evaluated as a matrix for conductive adhesives. Although the seven formulations prepared exhibited good low temperature flexibility and peel strength, tensile strength (110-200 psi) and electrical resistivity (>4 ohm-cm) were not satisfactory. Three commercial silicone adhesives were filled with Ag powder and evaluated as conductive adhesives. Peel strengths of all materials were poor. Attempts to increase the peel strength of LTV-602 adhesives by the addition of carbon black and three different tackifiers were unsuccessful. A study was made to determine whether Kr-in-Xe gas standards could be reused in calibrating proportional counting chambers. During the counting procedure the ^{85}Kr content of the gas was reduced from 2.4×10^{-10} at. % to 1.2×10^{-11} at. %. Thus, the gas standard cannot be reused. The gas is being analyzed to determine whether there was a change in isotopic ratio of the mixture. Tracer-level ^{227}Ac was satisfactorily separated from its daughter products by ion exchange on Dowex AG50W-X8. The Ac was eluted in the 4 M HNO_3 fraction, as confirmed by alpha energy analysis. Separation and purification of ^{234}U from aged ^{238}Pu solutions by a combination of anion exchange and solvent extraction techniques are reported. A sample was processed through the anion exchange step resulting in a solution which contains 1.94 g U (87% recovery) and 1.20 g Pu (1.1% of original). A final purification step was applied to the U product. Solvent extraction techniques with tributyl phosphate are being developed. Sodium carbonate and hydroxylamine hydrochloride are being studied as stripping agents in cold work related to this separation. (auth)

45174 (MLM-1204) MOUND LABORATORY PROGRESS REPORT FOR JUNE 1964. J. F. Eichelberger, G. R. Grove, and L. V. Jones (Mound Lab., Miamisburg, Ohio). Sept. 18, 1964. Contract AT(33-1)-Gen-53. 23p.

The neutron emission rate of plutonium–beryllium sources made with plutonium-239 is increasing due to the ingrowth of americium-241. The emission rate is being measured to determine if the growth rate can be predicted on the basis of calorimetric measurements. The tritium content in helium-3 was reduced approximately 50% to 3×10^{-8}% by passing the gas over cupric oxide at 700°C. A method of separating helium-3 and helium-4 that takes advantage of the superfluid properties of helium-4 was developed. In a series of 10 experimental runs, helium-3 was enriched from 0.08 atom % to more than 14 atom %. In the program to enrich xenon-136 the product was withdrawn regularly from the five-stage system to establish conditions maintaining the concentration of xenon-131 below one percent. A new longitudinally finned gas chromatographic column was used to reduce the krypton-85 in the xenon. Results were better than those with previous columns. A computer program was developed to calculate column transport coefficients as a function of pressure for a given temperature and column geometry from the McInteer and Reisfeld table of shape factors. Its uniqueness is the development of special interpolation techniques to obtain accurate shape factors from original data stored in the computer. The half-life of promethium-147, which was prepared at the Hanford Laboratories, was 2.6244 ± 0.006 years with an estimated absolute error limit of 0.0006 years. The power and average beta energy for promethium were determined to be 0.33267 watts per gram and 60.54 kev, respectively. The contents of one of three actinium slugs were processed through the ion-exchange column. Uranium-234 is separated from aged plutonium-238 solutions by a combination of anion exchange and solvent extraction techniques. A sample containing nearly two grams of uranium-234 was previously processed by an anion exchange procedure to separate the uranium from 99% of the plutonium. A hexone extraction reduced the plutonium level further and separated the uranium from the bulk of the inactive contaminants. The product from the hexone step

contained 1.96 grams of uranium and 2.9 milligrams of plutonium. A study of the denitration of acid solutions with sugars showed that dextrose was better than sucrose as a denitrating agent. Three commercial systems, Humiseal 2A60 (a polyurethane system), DC 269 and RTV 615, both silicone systems, were evaluated as matrices for flexible conductive adhesives. All three were unsatisfactory. The addition of 9% low viscosity depolymerized rubber to a carbon black silicon formulation increased the peel strength of the formulation from 0.5 to 4.0 lb/in. (auth)

45175 (MLM-1209) MOUND LABORATORY PROGRESS REPORT FOR JULY 1964. J. F. Eichelberger, G. R. Grove, and L. V. Jones (Mound Lab., Miamisburg, Ohio). Sept. 25, 1964. Contract AT(33-1)-Gen-53. 18p.

A method of separating helium-3 from helium-4 in the liquid phase by a combination "superleak" and "heat flush" technique is being studied. Helium-3 enrichments to about 11% were obtained. Experiments with a single column have led to revised values of transport coefficients for the 11-column carbon-13 cascade. The neon-22 draw-off run was completed in the processing of intermediate material used for enriching neon-21. Batch operation was started, and the column profile showed that the neon-21 had reached a concentration of about 48%. In the initial test run to enrich the heavy krypton isotopes, krypton-84 and -86 were enriched to 92% at the bottom of the cascaded thermal diffusion column system. Heavy xenon product is being drawn off at a rate of 21 ml per day from the five-stage cascaded swing system. The concentration of xenon-131 remains below 0.7%. A separation of krypton-85 and xenon was made using Formula 676 and dry ice as the coolant for the chromatograph column. Although this mixture was reported to give a lower temperature than that of trichloroethylene and dry ice, the separation factors were similar. The omega integrals are being evaluated for analyzing gas transport properties and as a link between the theoretical molecular potential and the physical properties of a gas. A new variable geometry vacuum chamber adaptable to any of the solid state detectors in use is being fabricated. The ratio of alpha activities, $\alpha^{208}Po/\alpha^{209}Po$, in a source containing both isotopes is being measured as a function of time. Alpha spectrometry results and calorimetry data yielded widely disparate results for the half-life of polonium-209. A calorimetric determination of half-life of polonium-210 gives a value of 138.3763 ± 0.0017 days. The half-life of polonium-210 redetermined by the method of decaying pairs is 138.7 ± 0.4 days. The polonium electrode potentials in HCl solutions were investigated. The standard electrode potential was found to be −0.70 volt. The two remaining actinium slugs of a group of three were opened and dissolved in HCl. The eluted fractions will be analyzed for actinium by alpha counting. The long-lived radioactive impurity in the thorium-228 half-life sample was identified positively as actinium-227. The half-life was recalculated; it is 1.91319 ± 0.00050 years. Good separation of barium-140 and lanthanum-140 is obtained when the dried residue is converted to a fluoride and leached with water. In this case, the barium-140 is desorbed, and the lanthanum-140 is retained by a platinum surface. However, when a chloride residue on glass is leached with a mixture of ethyl or n-butyl alcohol and concentrated HCl, the lanthanum-140 is preferentially desorbed, while the barium-140 is retained by the glass surface. A conductive silicone adhesive laminate system having peel strength of 5.0 lb/in. exhibited an electrical resistivity of 0.2 ohm-cm, an ultimate elongation at −65°F of 40%, and a plug tensile strength of 122 psi. The standard method of polonium urinalysis was modified to obtain greatest sensitivity of measurement. By the original method the Maximum Permissible Concentration (MPC) in the human body gave 0.95 alpha count per minute. By the new method the MPC yields 3.80 counts per minute. (auth)

45176 (NYO-10544(Rev.)) ADSORPTION OF ZINC (AND SILVER) ON SILT AND WATER HANDLING SURFACES. Final Report. Charles E. Renn (Johns Hopkins Univ., Baltimore). Sept. 1964. Contract AT(30-1)-2536. 27p.

Radiotracer techniques were used in the following studies: Radio-Zinc Binding in Soft Clams. The mode of feeding of Mya arenaria and the manner in which it secures Zn from silt and organic detritus were studied. It was found that the clam can flocculate and settle Zn-bearing fines from suspension and that high Zn concentrations appear in the mantle, siphon, and fecal strings. Redistribution of Silt-Bound Zinc by Aquatic Annelids. It was demonstrated that the major fraction of the adsorbed Zn remained adsorbed on the scoured fecal strings deposited by the tubificid worms. Adsorption of Trace Concentrations of Silver on Water Handling Surfaces. A study was made of the behavior of Ag traces in underdesigned silver-based water disinfecting systems. Several test surfaces were used, and the effects of atmosphere, pH, and organic matter on Ag adsorption were studied. (D.L.C.)

45177 (ORNL-P-445) THE FREEZING AND THAWING OF ISOLATED CELLS. Peter Mazur (Oak Ridge National Lab., Tenn.). [Sept. 10, 1964]. Contract [W-7405-eng-26]. 39p. (CONF-728-1)

From American Cancer Society Conference on Cryobiology, Rye, N. Y., Oct. 1964.

Factors that cause injury and loss of viability during freezing and thawing of isolated cells are discussed. Yeast and red blood cells are discussed in detail. (C.H.)

45178 (ORNL-P-483) ON THE CHEMISTRY OF CHROMOSOME CONTINUITY. Sheldon Wolff (Oak Ridge National Lab., Tenn.). [1964]. Contract [W-7405-eng-26]. 28p. (CONF-734-1)

For presentation at Symposium on Genes and Chromosomes Structure and Function, Buenos Aires, Nov.-Dec. 1964.

Data available on chromosome structure are reviewed. Results are reported from experiments on the metabolic requirements for the repair of radiation-induced chromosome breaks, experiments on the types of aberrations induced at various stages of the cell cycle, and experiments on enzyme digestion of isolated mitotic nuclei and chromosomes of Vicia faba. Results indicate that the mitotic chromosomes of Vicia faba depend in the main upon nonhistone protein for their linear continuity and are multistranded structures. The results obtained with Vicia faba chromosomes, in general, seem to fit those obtained with many other organisms. The one major exception being the results obtained by some workers, but not all, on lampbrush chromosomes of the newt. (auth)

45179 (SC-DC-64-1450) COMPARISON OF WIND TUNNEL AND FLIGHT DATA FOR A HYPERSONIC INSTRUMENTATION ROCKET. Randall C. Maydew (Sandia Lab., Albuquerque, N. Mex.). Sept. 1964. Contract [AT(29-1)-789]. 27p. (CONF-752-1)

From 22nd Meeting of the Supersonic Tunnel Assoc. at the von Karman Institute for Fluid Dynamics, Rhode-Saint-Genese, Belgium, Sept. 1964.

The static stability characteristics of 0.0833- and 0.139-scaled models of a high-fineness-ratio instrumentation rocket were measured in a trisonic and a hyper-

sonic tunnel at Mach numbers up to 7.6. These wind tunnel data correlate fairly well with the telemetered static stability data from two Nike-Tomahawk flight tests. (auth)

45180 (SC-DC-64-1453) ELASTIC CONSTANTS OF PLASTIC CRYSTALS. Final Report. John R. Green (New Mexico. Univ., Albuquerque). July 20, 1964. Contract AT(29-1)-789. 25p.

Progress is summarized on the following topics in the research program: crystal growth, dielectric studies of the phase transformation of cyclohexanol, density measurement, propagation of ultrasound in a cubic solid, and ultrasonic studies of camphene and cyclohexanol. (D.L.C.)

45181 (SC-DC-3550) SUGGESTED DESIGN CRITERIA FOR STANDARDS LABORATORIES. H. H. Baxter, Jr. (Sandia Corp., Albuquerque, N. Mex.). [Nov. 1963]. Contract AT(29-1)-789. 37p.

A discussion is presented of what the ever-increasing demand for accuracy requires in standards-laboratory planning and design The location, room arrangements and dimensions, structural shell, entrances and windows, utilities, and environments are treated. Clean rooms are also discussed. (D.L.C.)

45182 (SC-R-64-145A) BASIC DESIGN REQUIREMENTS FOR LAMINAR AIR FLOW DUST CONTROL DEVICES. W. J. Whitfield, J. C. Mashburn, W. E. Neitzel, and L. C. Trujillo (Sandia Corp., Albuquerque, N. Mex.). May 1964. Revised Aug. 1964. Contract AT(29-1)-789. 23p. (CONF-735-1)

From National Meeting of the American Association for Contamination Control, Los Angeles, May 1964.

Laminar air flow principles and basic design requirements are given for laminar air flow clean rooms, clean benches, and laminar flow hoods. Also discussed are: final filter mounting requirements, plenum design, location of clean room lighting, clean room construction materials, air ducts, air distribution, clean room floors, and noise control design considerations. (auth)

45183 (SC-R-64-175) THE UNIQUE ROLE OF NONDESTRUCTIVE TESTING IN DEVELOPMENT PROGRAMS. D. W. Ballard (Sandia Corp., Albuquerque, N. Mex.). July 1964. Contract AT(29-1)-789. 14p. (CONF-738-1)

From the American Society of Mechanical Engineers Design Engineering Conference and Show, Chicago, May 1964.

While the use of nondestructive test methods such as radiography and ultrasonics has shown a tremendous increase on the production line, the designer has often failed to capitalize on the unique benefits of these tools during development programs. The importance of the designer reviewing his nondestructive test programs in the light of more demanding requirements for nuclear and aerospace componentry is pointed out. Close teamwork is urged between the designer and test engineer in the planning and execution of a comprehensive nondestructive testing program. Benefits resulting from this cooperation include a better correlation of design and production test data, more information from destructive tests, fewer expensive destructive tests during development, a source of unique test data hitherto unavailable to the designer, and a more definitive product design. Examples are given of each of these benefits without explaining in detail the specific nondestructive test methods involved. Consequently, the discussion is directed towards designers with some background in available testing techniques, but not necessarily expert in any of the recognized nondestructive test methods. (auth)

45184 (SC-R-64-176) CONSIDER THE ACCEPTANCE METHOD WHEN REVIEWING THE DESIGN. E. S. Roth (Sandia Corp., Albuquerque, N. Mex.). June 1964. Contract [AT(29-1)-789]. 14p. (CONF-454-2)

From Western Region Quality Control Conference, Portland, Ore., Apr. 1964.

A single part is usually defined using many different dimensioning and tolerancing methods. This practice puts the inspection process designer on the spot since he should use all of the different inspection methods (surface plate inspection, "go" and "not-go" gages, functional receiver gages, optical chart gages) demanded by the drawing. The inspection process can be optimized if it becomes a design consideration. (auth)

45185 (SC-R-64-1319) MINIMIZING POSSIBLE SEPARATION BETWEEN ENCAPSULATION MATERIALS AND INTEGRAL PLASTIC HOUSINGS. R. M. Curlee (Sandia Corp., Albuquerque, N. Mex.). Aug. 1964. Contract AT(29-1)-789. 16p. (CONF-741-1)

From Western Electric Company, 1964 Casting Resin Conference, Indianapolis Works, Apr. 1964.

Results are described of tests performed to determine the significant variables influencing the separation of encapsulation materials from molded plastic housings. The effects of housing design and material, housing preparation, the type of encapsulant, and various processing techniques were investigated in order to solve a production problem and to provide design information for future electronic packages. (auth)

45186 (SC-R-747) OPTICAL INSPECTION OF CONSTANT FORM ELEMENTS. E. S. Roth (Sandia Corp., Albuquerque, N. Mex.). Jan. 1964. Contract AT(20-1)-789. 7p.

Principles of chart gage design using positional and form tolerances are discussed. The effects of RFS and MMC specification to part datum-axes and tolerances on part fixturing and alignment are described. The paper was presented at an ASTME seminar on precision measurement of cylindrical-surface elements. (R.E.U.)

45187 (SC-TM-64-981) WIND TUNNEL FORCE TESTS OF THE STRYPI II TEST VEHICLE AT MACH 5 AND 7.5. Program VI-7. Roger N. Everett (Sandia Lab., Albuquerque, N. Mex.). Sept. 1964. Contract [AT(29-1)-789]. 43p.

A 0.0645-scale model of the STRYPI II test vehicle was tested in the Sandia 18-inch hypersonic wind tunnel to determine drag and stability data. The model was tested with and without boosters at roll angles of 0, 45, and 90 degrees through an angle-of-attack range of ±6 degrees at Mach 5 and 7.5. Normal force, axial force, and pitching moment coefficients as well as starting load data are presented. All configurations tested were statically stable. (auth)

45188 (SC-TM-64-987) IMPACT SHOCK ON A BLUNT-NOSED MISSILE STRIKING WATER WITH ITS AXIS NORMAL TO THE WATER SURFACE. Dallas D. Laumbach (Sandia Corp., Albuquerque, N. Mex.). Sept. 1964. Contract [AT(29-1)-789]. 22p.

Impact shock equations are derived for normal impact on smooth surface water. Using an equation of state for water, pressures are determined for supersonic and subsonic impact velocities. Duration times of impact pressures are also determined. (auth)

45189 (TID-19758) CARDIAC FUNCTION CURVES IN CONSCIOUS DOGS. V. S. Bishop, H. L. Stone, and A. C. Guyton (Mississippi. Univ., Jackson. Medical Center). [1963]. Contract [AT(40-1)-3111]. 19p.

Different types of ventricular function curves were determined over a period of several weeks in seven conscious dogs. The atrial pressures were raised by infusing Tyrode's solution through a large catheter chronically implanted in the left jugular vein while recording systemic arterial pressure, right and left atrial pressures, heart rate, and ventricular output. Ventricular output was measured continually by chronically implanted electromagnetic flow probes. Right and left ventricular minute volume output curves, stroke volume output curves, left ventricular minute work curves, and left ventricular stroke work curves were obtained every few days on all animals. The results of the minute volume output curves were almost reproducible in each animal from day to day. (auth)

45190 (TID-21015) DETAILED LISTING OF BASE CHARGES FOR U-235 ENRICHED AND DEPLETED URANIUM AS UF_6. (Oak Ridge Operations Office. Production Div., AEC). Sept. 1964. 60p.

Current base charges are listed for each 0.0001 weight fraction ^{235}U for assays ranging from 0.0038 to 0.98 weight fraction ^{235}U. (D.L.C.)

45191 (TID-21152) INTERACTION OF BACTERIAL CELLS WITH FOREIGN NUCLEIC ACIDS. Progress Report, November 1, 1963 to October 31, 1964. William Ginoza (Pennsylvania State Univ., University Park). Sept. 10, 1964. Contract AT(30-1)-3116. 9p.

Thermal inactivation kinetics of three single-stranded viral nucleic acids, TMV-RNA, R17-RNA, and ϕX174-DNA, examined over a range of pH and temperature, indicate that two classes of nucleic acids, RNA and DNA, are inactivated by distinctly different first-order processes. They are consistent with the conclusion that scission of a single phosphodiester bond inactivates the RNAs while a single depurination event inactivates ϕX174-DNA. Results are reported from studies on the synthesis of β-galactosidase in protoplasts of Z^- strains of E. coli, Hfr with purified m-RNA derived from a related strain which produces a high quantity of this enzyme. A very sensitive test substrate, β-galactoside of fluorescein was used to test fluorophotometrically the possible enzymatic release of fluorescein in extracts of cells exposed to RNA. Radiation target analysis of T4 bacteriophage was initiated. The target size for plaque formation is 6×10^6. The sensitive mass is the same whether the irradiated virus is assayed on E. coli strains B, K, Bs (strain unable to dark-photoreactivate), or auxotrophic mutants. Marker (rII) rescue experiments indicate that the main cause of x ray inactivation of T4 is not, as reported in the literature, due to failure to inject its DNA. Attempts at identifying the 6×10^6 target are reported in progress. A quantitative microbiological assay, employing a purine auxotroph of E. coli, was developed to estimate submicrogram amounts of free purines. (auth)

45192 (TID-21157) BIOLOGICAL UPTAKE IN SHALLOW BENTHIC ENVIRONMENTS. Progress Report, September 7, 1964. Nelson Marshall (Rhode Island. Univ., Kingston. Graduate School of Oceanography). Contract AT(30-1)-2678. 62p.

Niantic Bay and the estuarine basin of the Niantic River, Rhode Island, were studied as source areas of phytoplankton transported across the shoals which separate the upper estuary and the coastal waters. These waters support dense populations of bay scallops and other benthic filter feeders. Surface and bottom stations in the Bay and estuarine basin and stations over the shoals, where tidal excursions alternately transport water from offshore and from the estuary, were sampled at 5-wk intervals for 1 yr. Data are presented on the volume and phytoplankton species; characteristics of the waters adjacent to the substrate in the tidal shoals area of the Niantic Estuary, and primary productivity of the benthic microflora. (C.H.)

45193 (UCRL-7762(Rev.I)) CALCULATION OF THE SHOCK WAVE FROM AN UNDERGROUND NUCLEAR EXPLOSION IN GRANITE. Theodore R. Butkovich (California. Univ., Livermore. Lawrence Radiation Lab.). May 7, 1964. Contract W-7405-eng-48. 20p.

The capability of calculating the close-in effects of the shock wave from an underground nuclear explosion has been demonstrated. Agreement was obtained between calculation and measurements using a spherically symmetric hydrodynamic, elastic-plastic code called SOC for the Hardhat event, a 5-kiloton nuclear detonation in granite. This capability is dependent upon having a more or less complete description of the elastic and dynamic properties of the materials involved. When this information is available, agreement within the limits of uncertainty of the measurements can be calculated for peak pressures, peak particle velocities, shock wave time of arrival, and pressure pulse shapes. (auth)

45194 (UCRL-11480) VACANCY AGGREGATES IN QUENCHED COPPER SINGLE CRYSTALS. W. Bell, D. M. Maher, and G. Thomas (California. Univ., Berkeley. Lawrence Radiation Lab. and California. Univ., Berkeley). June 1964. Contract W-7405-eng-48. 33p. (CONF-615-4)

From International Conference on Lattice Defects in Quenched Metals, Argonne, Ill., June 1964.

Copper single crystals of 99.999+ purity have been gas quenched from vacuum and aged under controlled conditions. In all cases planar, vacancy aggregates have been identified by dark field electron microscopy techniques. Both perfect and imperfect prismatic loops have been observed, but the former appear to be more numerous. The maximum size of imperfect loops does not exceed 125Å, whereas perfect loops range in size from 100 to 200Å. The results suggest that the perfect loop forms from the imperfect loop at some critical stage during growth. (auth)

45195 (UCRL-11513) LIQUID-SOLID TRANSFORMATION KINETICS IN ALUMINUM OXIDE (thesis). Amio R. Das (California. Univ., Berkeley. Lawrence Radiation Lab.). July 15, 1964. Contract W-7405-eng-48. 63p.

A direct-current-arc plasma torch was used to subject sized particles of synthetic sapphire in the range of 9 to 124 microns to rapid melting and resolidifcation. The spherical particles resulting from the solidification of completely molten droplets were separated from the partially melted particles in order to study the formation of metastable crystalline phases of alumina from the liquid droplets subjected to rapid cooling. A fraction of these spheroidized particles showed various degrees of bubble formation. The size and apparent density of the spheroidized particles and the ambient temperature conditions experienced by the liquid droplets during cooling were used as parameters in determining quenching rates. A hypothesis based on the kinetics of nucleation of the crystalline solid phases from the supercooled liquid droplets is proposed to explain the ratio of metastable phases to the stable α phase. Experimental data relating this ratio with quench

rates of the liquid droplets show reasonable agreement with the proposed hypothesis. (auth)

45196 (WERL-8844-1) ENERGY RELEASE RATES FOR BIAXIAL BRITTLE-FRACTURE TEST SPECIMEN. A. M. Wahl, M. M. Leven, and W. K. Wilson (Westinghouse Electric Corp. Research Labs., Pittsburgh). May 23, 1963. Contract NObs-78844. 20p.

Utilizing theoretical, photoelastic, and compliance methods, expressions for energy release rates G, as utilized in fracture mechanics, are determined for the biaxial brittle fracture specimen designed by M. J. Manjoine. The results for the various methods were found to be in reasonable agreement and indicate that the constant utilized previously in the formula for calculating G values for this specimen is about four times too high. (auth)

45197 (JPRS-26803) ARTICLES FROM SOVIET JOURNALS ON THE ORGANIZATION OF SCIENTIFIC RESEARCH IN THE USSR. Translated from At. Energ. (USSR), No. 2, 173-4(1964); Meteorol. i Gidrol., No. 6, 62-3(1964); and Metallurg, No. 6, 39(1964). 11p. (TT-64-51060)

Translations are presented of four selected short articles which treat the following: radioisotope uses in the Ukraine, agrometeorological services and facilities, and achievements of ferrous metallurgy in the national economy. A separate abstract was prepared for the article on radioisotopes. (D.L.C.)

For an abstract of the individual paper see: 44000.

45198 EDUCATION AND THE ATOM — AN EVALUATION OF GOVERNMENT'S ROLE IN SCIENCE EDUCATION AND INFORMATION, ESPECIALLY AS APPLIED TO NUCLEAR ENERGY. Glenn T. Seaborg (Atomic Energy Commission, Washington, D. C.); and Daniel M. Wilkes (California. Univ., Berkeley. Lawrence Radiation Lab.). New York, McGraw-Hill Book Co., 1964. 163p. $18.00.

An examination is presented of the relationship of the Federal Government to higher education. AEC activities in education and information services are described. Nuclear engineering, medicine, health protection, undergraduate education, and high schools are treated. Activities in public information and international affairs are also discussed. (D.L.C.)

45199 PARACHUTE DEPLOYMENT CONTROL ASSEMBLY. H. E. Widdows (to U. S. Atomic Energy Commission). U. S. Patent 3,145,956. Aug. 25, 1964.

An improved parachute assembly was developed for reducing damage to the parachute under high-speed operation. This parachute was designed to reduce the opening shock load on the parachute canopy and prevent twisting of the canopy in the deployment bag. The assembly is divided into sections and is arranged so that after impact a sequence of cutting operations occurs to gradually release the parachute canopy and suspension lines. (AEC)

45200 ATMOSPHERIC EDDY DISTURBANCE DETECTOR. Harry Moses (to U. S. Atomic Energy Commission). U. S. Patent 3,146,622. Sept. 1, 1964.

Devices were developed for measuring and recording two dimensional patterns of atmospheric temperature or wind velocity. To measure temperature, a plastic tape, opaque to infrared radiation, is scanned by a rotating plane mirror mounted on a constant speed motor. A lens focuses the reflected radiation on an infrared detector cell whose output is amplified so that it may be displayed on an oscilloscope containing a horizontal raster representing the successive scans of the tape. For measuring velocity the tape is replaced with wires, which are suspended in the atmosphere and connected in parallel with a constant voltage source. The cooling of the wires is proportional to wind velocity and is detected and displayed by the same infrared detector and oscilloscope. Means for calibrating the device and for shielding the sensors from solar and ground radiation are described. (AEC)

45201 GLASS OF HIGH ULTRAVIOLET TRANSMITTANCE, METHOD, AND ARTICLES MANUFACTURED THEREFROM. Adli M. Bishay (to U. S. Atomic Energy Commission). U. S. Patent 3,150,281. Sept. 22, 1964.

A glass with high ultraviolet transmittance is described. It has the following molar proportions: 4.5 B_2O_3, 1.0 Al_2O_3, and 1.0 K_2O. (AEC)

45202 LUBRICATION OF MANDRELS FOR TUBE EXTRACTION. Billie J. Buntz and Lester A. Unnerstall (to U. S. Atomic Energy Commission). U. S. Patent 3,153,482. Oct. 20, 1964.

A device was developed for lubricating a tube-extrusion mandrel ahead of its supporting bearing, thereby providing highly accurate centering of the mandrel in the extrusion die and greatly extending mandrel life. A lubricant well is provided ahead of the bearing and is filled by displacement of lubricant from a piercing cap as the mandrel moves forward into the piercing cap. (AEC)

45203 METHOD AND DEVICE FOR CONTROLLING ULTRASONIC WELDING APPARATUS. Daniel C. Worlton and Ray A. Walker (to U. S. Atomic Energy Commission). U. S. Patent 3,153,850. Oct. 27, 1964.

A method for effecting improved ultrasonic welds is described. In an ultrasonic welding device having a welding head for applying force and ultrasonic energy to a workpiece, means are provided responsive to the welding head for producing an electrical signal proportional to the instantaneous displacement of the head. Means are provided responsive to a predetermined value decrease in the instantaneous amplitude of the produced electrical signal for stopping the welding process. (AEC)

CORPORATE AUTHOR INDEX

This index contains entries for this period for all report literature and, in addition, for certain published literature items for which it is felt that a corporate approach is especially desirable, e.g., symposia, conference proceedings, and meetings.

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ä	becomes	ae
ö		oe
ø		oe
ü		ue (except in transliterated Chinese names)

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SUBJECT INDEX

Main entries in this index are generally specific materials, things, and processes. These are followed by modifiers that describe the properties of, and processes applied to, the main entries.

The number preceding the colon is the *NSA* volume number, and the number following is the abstract number. The designation (R) following the abstract number indicates that the abstract is of a progress report; (P) indicates a patent; and (T) indicates a translation. Abstracts for reports other than progress reports carry no letter designation. References to report numbers, where appropriate, are included after the abstract number of the citation. Published literature (journal article or book) is indentifiable by the absence of a report number.

General Indexing Style

The user should bear in mind that the ideas presented in the original literature, rather than key words, have been indexed. The indexers have tried to select what seemed the most probable and logical place to look for typical information. Since it is not possible to anticipate where a user would look for information, numerous cross references are included to assist him in his search.

Experience in using an index of this type will be the best guide in obtaining the desired information, and a consideration of synonymous or closely related terms will prove valuable.

Information must be so indexed as to be of the greatest use to the greatest number of users. This requires that a topic be indexed to headings that most specifically describe it and not ordinarily to the headings that describe its ultimate use, nor to the general class headings that include the specific headings. For example, information on the treatment of thyroid disease with I-131 would be indexed under Thyroid Diseases and under Iodine Isotopes I-131, but not necessarily under Radiotherapy. A study of the effects of x radiation on hair would be indexed under both X Radiation and Hair. However, the information would not be indexed under the experimental animal, e.g., Rats, unless the report discusses the effects on rat hair as compared with the effect on the hair of other animals.

The broad, general class headings are used only for general information or for comprehensive reports or articles.

Subject Heading Styles

Generally, the direct form of subject entry is used rather than inverted headings or, in some cases, subheadings; e.g., Amino Acids rather than Acids, amino; Helium Isotopes He-4 rather than Helium — isotopes He-4 or Helium — He-4 isotopes. Note, however, that in some cases modifying terms are used parenthetically in preference to a more direct type of entry which would result in the scattering of information. Organic compounds, however, are usually entered in the index in the inverted form so that substituted compounds can be listed near the parent compound; e.g., Benzene, Bromo- rather than Bromobenzene. In general, the style of nomenclature used is that of *Chemical Abstracts*, except that some items listed in that publication as subheadings are elevated to form part of the main heading; e.g., Butyric Acid, Methyl Ester rather than Butyric Acid — methyl ester.

Alphabetization

Main headings are arranged according to the widely accepted word-by-word alphabetic system. A parenthetic qualifier following a main heading is disregarded in alphabetizing unless there are two or more headings identical except for the parenthetic qualifier, in which case the qualifier determines the order. Headings involving Greek letters are arranged as if the names of the letters were spelled out, e.g., Mesons (π), Mesons (ξ).

Nomenclature of Inorganic Compounds

Inorganic compounds are indexed in the direct form, listing cations in the order of increasing valence in the case of polycationic salts of varying valence and in alphabetic order for polycationic salts in which all cations have the same valence; e.g., Sodium Aluminum Silicates and Potassium Sodium Sulfates.

Multicomponent Systems

Multicomponent alloys, except well-known trade names are indexed under each element in the alloy.

Example: Aluminum–Chromium Alloys are indexed

ALUMINUM ALLOYS
Al–Cr ...
CHROMIUM ALLOYS
Al–Cr ...

Well-known alloys such as Hastelloy are indexed directly with cross references under the element components. Multicomponent systems of elements are indexed similarly.

Example: Silicon–Tungsten Systems are indexed

SILICON SYSTEMS
Si–W ...
TUNGSTEN SYSTEMS
Si–W ...

Multicomponent systems of compounds are similarly indexed under the compound.

Physical States of Materials

In this subject index specification of the physical state of the material, if other than normal, is included in the modifying phrase.

Modifying Phrases (Subheadings)

Descriptive phrases (modifiers), rather than ordinary subheadings, are used under the main headings to give a better indication of the material covered in an abstract than would be possible with only a word or two whenever it appears that such information would be useful. Such phrases are written so that the idea considered most important is presented first, should a not-too-awkward expression result. However, when using this index, the reader is advised to scan all modifiers under a main heading to determine whether any abstracts in addition to the most obvious should be consulted for the desired information. Many of the modifiers are designed to be read in inverted order or to be read with the main heading inserted at the position of the comma in order to obtain a meaningful phrase; e.g., Uranium—allotropic transformation temperatures of, effect of cooling rate on is read "effect of cooling rate on allotropic transformation temperatures of uranium." In many cases, the prepositions have been omitted from such phrases provided no ambiguity results from the omission.

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CONF-716–	**(American Ceramic Society, Philadelphia, Sept. 17, 1964)**	
1	18-44041	See MATT-293
2	18-44061	See SC-R-64-1330
CONF-717–	**(CNRS Meeting on Graft of Allogenic Hematopoietic Cells, Paris, Sept. 7–9, 1964)**	
1	18-43226	See ORNL-P-394
2	18-43216	See BNL-8387
CONF-718–	**(American Institute of Chemical Engineers Meeting, Las Vegas, Nev., Sept. 21, 1964)**	
1	18-43747	See UCRL-7963
CONF-719–	**(5th International Conference on Microwave Tubes, Paris, Sept. 14–18, 1964)**	
1	18-44322	See SLAC-PUB-49
2	18-44321	See SLAC-PUB-48
CONF-720–	**(2nd Symposium on Protection Against Radiation Hazards in Space, Gatlinburg, Oct. 1964)**	
1	18-43320	See ORNL-P-322
CONF-721–	**(8th Conference on Analytical Chemistry in Nuclear Technology, Gatlinburg, Oct. 1964)**	
1	18-43369	Dep.(mn); $1.00(cy), 1(mn) OTS
2	18-43385	See ORNL-P-447
3	18-43898	See Y-KG-24
CONF-722–	**(American Society of Zoologists Southern Regional Meeting, Houston, Tex., Oct. 1963)**	
1	18-45164	Dep.(mn); $1.00(cy), 1(mn) OTS
CONF-724–	**(German Physical Society Conference, Dusseldorf, Ger., Oct. 1964)**	
1	18-44676	See ORNL-P-488
CONF-725–	**(3rd International Symposium on Regulation of Enzyme Activity and Synthesis in Normal and Neoplastic Tissues, Indianapolis, Ind., Oct. 1964)**	
1	18-43186	See ORNL-P-490
CONF-726–	**(British Ceramic Society Conference, Brighton, Eng., Oct. 1964)**	
1	18-44107	See ORNL-P-427
CONF-727–	**(10th Annual Bioassay and Analytical Chemistry Meeting, Cincinnati, Oct. 1964)**	
1	18-43322	See RFP-431
3	18-43370	See DPSPU-64-30-20
CONF-728–	**(American Cancer Society Conference on Cryobiology, Rye, N. Y., Oct. 1964)**	
1	18-45177	See ORNL-P-445

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CONF-729–	**(International Conference on Beryllium, Philadelphia, Oct. 1964)**	
1	18-44063	See UCRL-7591
CONF-731–	**(IAEA Symposium on Radiochemical Methods of Analysis, Salzburg, Austria, Oct. 1964)**	
1	18-43387	See ORNL-P-479
2	18-43386	See ORNL-P-473
CONF-732–	**(Conference on the Mechanisms of the Dose Rate Effect at the Genetic and Cellular Level, Oiso, Japan, Nov. 1964)**	
1	18-43229	See ORNL-P-472
2	18-43228	See ORNL-P-449
CONF-733–	**(8th International Congress of Internal Medicine, Buenos Aires, Nov. 1964)**	
1	18-43227	See ORNL-P-419
CONF-734–	**(Symposium on Genes and Chromosomes Structure and Function, Buenos Aires, Nov.–Dec. 1964)**	
1	18-45178	See ORNL-P-483
CONF-735–	**(National Meeting of the American Association for Contamination Control, Los Angeles, May 1964)**	
1	18-45182	See SC-R-64-145A
CONF-737–	**(IGY/IGC Symposium, University of California, Los Angeles, Aug. 1963)**	
1	18-44481	See EFINS-63-68
CONF-738–	**(American Society of Mechanical Engineers Design Engineering Conference and Show, Chicago, May 1964)**	
1	18-45183	See SC-R-64-175
CONF-739–	**(United States Army Nuclear Science Seminar, Oak Ridge, Tenn., Aug. 1964)**	
1	18-45087	See ORNL-P-325
CONF-740–	**(24th Annual Conference on Physical Electronics, Massachusetts Institute of Technology, March 25, 26, and 27, 1964)**	
1	18-44492	See AFCRL-64-12
CONF-742–	**(15th CITCE Meeting (Internat'l Comm. on Thermodynamics and Electrochemical Kinetics), London, England, September 20–26, 1964)**	
1	18-43445	See ORNL-P-324
CONF-743–	**(Conf. on "Large Steerable Antennas–Climatological and Aerodynamical Considerations," New York Academy of Sciences, New York City, New York, September 4–6, 1963)**	
1	18-45161	See BNL-7328
CONF-744–	**(Report on Insect Control by Sterile Male Technique (IAEA), Vienna, Austria, July 20–24, 1964)**	
1	18-43225	See ORNL-P-388
CONF-745–	**(Midwestern Simulation Council, Urbana, Illinois, March 16, 1964)**	
1	18-44024	See WAPD-T-1685
CONF-746–	**(Association for Computing Machinery Regional Meeting, Atlanta, Georgia, October 15, 16, 17, 1964)**	
1	18-44019	See K-DP-364
CONF-747–	**(4th Symposium on Radioactivity in Scandinavia, Riso, Denmark, Oct. 5–6, 1964)**	
1	18-43799	See HW-SA-3688
CONF-748–	**(Symposium on Physics and Nondestructive Testing, Dayton, Ohio, Sept. 29–Oct. 1, 1964)**	
1	18-45169	See HW-SA-3697
CONF-749–	**(International Conference on Analytical Chemistry, Vienna, Austria, October 19–23, 1964)**	
1	18-43372	See HW-SA-3680
CONF-750–	**(Meeting of Richland Section–Instrument Soc. of America, Richland, Washington, Sept. 8, 1964)**	
1	18-45074	See HW-SA-3690
CONF-751–	**(Joint Eastern and Western Simulation Council Meeting, Pittsburgh, Pa., June 8–9, 1964)**	
1	18-44025	See WAPD-T-1701
CONF-752–	**(22nd Meeting of the Supersonic Tunnel Assoc. at the von Karman Institute for Fluid Dynamics, Rhode-Saint-Genese, Belgium, Sept. 24–25, 1964)**	
1	18-45179	See SC-DC-64-1450
CONF-753–	**(Symposium on Quantitative Electron Microscopy Held at Armed Forces Inst. of Pathology, Washington, D. C., March 29–April 3, 1964)**	
1	18-44479	ORINS
CONF-764–	**(Thermal Conductivity Conference, San Francisco, Oct. 15, 1964)**	
1	18-45170	See IS-1018
2	18-44135	See IS-1016
COO–		
7-329	18-44775	Nucl. Instr. Methods, 30: 73-6(1964)
32-101	18-43637	J. Phys. Chem., 68: 2582-9(1964)
32-102	18-43645	J. Phys. Chem., 68: 2947-52(1964)
382-48	18-44342	Dep.(mn); $1.00(cy), 1(mn) OTS
1117-6	18-43217	Dep.(mn); $1.00(cy), 1(mn) OTS
1148-88	18-45165	Dep.(mn); $1.00(cy), 1(mn) OTS
1148-89	18-45166	Dep.(mn); $1.00(cy), 1(mn) OTS
1277-6	18-44459	Phys. Rev. Letters, 13: 503-5(1964)
1365-1	18-43638	J. Phys. Chem., 68: 2590-4(1964)
CRRM–	**(Canadian)**	
1200	18-44133	Dep.; $1.00(AECL)
CU–	**(Misc.)**	
231	18-44520	See NEVIS-125
2663-11	18-45167	Dep.(mn); $3.00(cy), 2(mn) OTS
2663-12	18-43781	Dep.(mn); $3.00(cy), 1(mn) OTS
DLCS–		
3070203	18-45011	Dep.(mn); $1.00(cy), 1(mn) OTS
5000664	18-45012	Dep.(mn); $2.00(cy), 1(mn) OTS
5000764	18-45013	Dep.(mn); $2.00(cy), 1(mn) OTS
5000864	18-45014	Dep.(mn); $2.00(cy), 1(mn) OTS
DM–	**(Misc.)**	
1369	18-44067	For translation see ORNL-tr-290
DPSPU–		
64-30-20	18-43370	Dep.(mn); $1.00(cy), 1(mn) OTS
DPST–		
64-416	18-45015	Dep.(mn); $3.00(cy), 2(mn) OTS
EAC–		
2	18-44860	See TID-21149
EFINS–	**(Misc.)**	
63-68	18-44481	$3.60(ph), $1.16(mf) OTS
64-38	18-44342	See COO-382-48
EIR–	**(Swiss)**	
70	18-43928	Dep.(mn)
EMRL–	**(Misc.)**	
24	18-45168	Dep.(mn); $3.00(cy), 1(mn) OTS
ERDE–	**(British)**	
12/R/62	18-44236	
ETR–	**(Belgian)**	
116	18-43713	See NP-11895
EUR–	**(European Atomic Energy Community)**	
535.i	18-44851	Dep.(mn)
1625.e	18-43529	Proceedings of the Conference on Methods of Preparing and Storing Marked Molecules, Brussels, November 13–16,

Report No.	Abstract No.	Availability
		1963. EAE Community, 1964
1652.f	18-45068	p.175-83 of "Comptes Rendus des Journées sur le Contrôle Optimum et les Systèmes Non-Linéaires–Saclay–13–15 June 1962"
1860.d	18-43400	J. Chromatog., 13: 266-8(1964)
1882.e	18-43997	Dep.(mn)
1899.e	18-45016	Dep.(mn)
1911.i	18-43708	Dep.(mn)
EURAEC–		
882	18-43771	Dep.(mn); $2.00(cy), 1(mn) OTS
972	18-43709	Dep.(mn); $2.00(cy), 1(mn) OTS
1101	18-44134	Dep.(mn); $2.00(cy), 1(mn) OTS
1122	18-44085	Dep.(mn); $3.00(cy), 2(mn) OTS
1153	18-43710	Dep.(mn); $1.00(cy), 1(mn) OTS
1191	18-45001	See CEND-2863-217
F–	**(Misc.)**	
B1973	18-44159	See WAL-TR-834.2/11-3
FTD-TT–	**(Non-AEC)**	
64-471	18-43450	OTS
64-506	18-44242	OTS
GA–	**(Misc.)**	
3997	18-43822	Dep.(mn); $1.00(cy), 1(mn) OTS
5073	18-43371	Dep.; $4.00(cy), 3(mn) OTS
GAMD–	**(Misc.)**	
2887	18-44701	Dep.(mn); $1.00(cy), 1(mn) OTS
2906	18-44702	Dep.(mn); $1.00(cy), 1(mn) OTS
3419	18-45017	Dep.(mn); $2.00(cy), 1(mn) OTS
3631	18-44420	Dep.(mn); $1.00(cy), 1(mn) OTS
GCA-TR–	**(Misc.)**	
64-1-N	18-44421	$3.60(OTS)
GEAP–	**(Misc.)**	
4350	18-45018	Dep.(mn); $5.00(cy), 4(mn) OTS
4617	18-45019	Dep.(mn); $6.00(cy), 6(mn) OTS
4619	18-45020	Dep.(mn); $4.00(cy), 3(mn) OTS
4633	18-44033	Dep.(mn); $4.00(cy), 3(mn) OTS
4647	18-45021	Dep.(mn); $3.00(cy), 2(mn) OTS
GEMP–	**(Misc.)**	
84	18-44936	Dep.; $2.00(cy), 1(mn) OTS
GNEC–		
327	18-45022	Dep.(mn); $5.00(cy), 3(mn) OTS
HMI-B–	**(German)**	
36	18-45082	Dep.(mn)
HW–		
80021	18-45083	Dep.; $2.00(cy), 1(mn) OTS
81473	18-45023	Dep.(mn); $1.00(cy), 1(mn) OTS
82651	18-44034	Dep.; $5.00(cy), 3(mn) OTS
82771(Pt.1)	18-45147	Dep.; $1.00(cy), 1(mn) OTS
82774	18-44039	Dep.(mn); $1.00(cy), 1(mn) OTS
83320	18-45148	Dep.; $2.00(cy), 1(mn) OTS
HW-SA–		
2925	18-44253	Carbon, 1: 255-61(1964)
3055(Rev.)	18-44237	Dep.(mn); $1.00(cy), 1(mn) OTS; Gmelin, AED-CONF-63-225-86
3094	18-43724	Nucl. Sci. Eng., 20: 362-4(1964)
3391	18-43839	Arch. Environ. Health, 9: 529-35(1964)
3575	18-45149	Dep.(mn); $1.00(cy), 1(mn) OTS
3679	18-45169	Dep.(mn); $2.00(cy), 1(mn) OTS
3680	18-43372	Dep.(mn); $2.00(cy), 1(mn) OTS
3688	18-43799	Dep.(mn); $1.00(cy), 1(mn) OTS
3690	18-45074	Dep.(mn); $1.00(cy), 1(mn) OTS
3715	18-43150	Dep.(mn); $3.00(cy), 2(mn) OTS
3716	18-43219	Dep.(mn); $4.00(cy), 2(mn) OTS
IA–	**(Non-AEC)**	
843	18-43600	Dep.(mn)
919	18-45084	Dep.(mn)
968	18-43443	Dep.(mn)

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IAE–	**(Russian)**	
603	18-43882	Dep.(mn)
616	18-43883	Dep.(mn)
617	18-43884	Dep.(mn)
IAEA–	**(Greek)**	
R206-1	18-43757	Dep.(mn)
IDO–		
12038	18-43318	Dep.(mn); $1.00(cy), 1(mn) OTS
14631	18-45150	Dep.; $2.00(cy), 1(mn) OTS
16953	18-43930	Dep.; $2.00(cy), 1(mn) OTS
16984	18-44703	Dep.; $3.00(cy), 1(mn) OTS
16998	18-44704	Dep.; $3.00(cy), 1(mn) OTS
16999	18-43885	Dep.; $3.00(cy), 2(mn) OTS
17000	18-44970	Dep.; $3.00(cy), 2(mn) OTS
IFA-M–	**(Rumanian)**	
32	18-43931	Dep.(mn)
33	18-43886	Dep.(mn)
34	18-43932	Dep.(mn)
37	18-43887	Dep.(mn)
INS-R–	**(New Zealand)**	
25	18-43800	Dep.(mn)
29	18-43788	Dep.(mn)
INSJ–	**(Japanese)**	
71	18-44728	Dep.(mn)
IS–		
789	18-43477	J. Chem. Phys., 41: 2818-27(1964)
846	18-44070	J. Less-Common Metals, 7: 288-95(1964)
857	18-43417	Talanta, 11: 1339-42(1964)
859	18-44228	p.397-407 of "[Nuclear Metallurgy. Vol. X. Symposium on Compounds of Interest in Nuclear Reactor Technology." New York, A.I.M.E., 1964]
881	18-44628	Nuovo Cimento (10), 34: 436-41(1964)
889	18-44826	Phys. Rev., 136: A738-44(1964)
897	18-44229	p.581-606 of "[Nuclear Metallurgy. Vol. X. Symposium on Compounds of Interest in Nuclear Reactor Technology." New York, A.I.M.E., 1964]
985	18-44137	Dep.(mn); $1.00(cy), 1(mn) OTS
1016	18-44135	Dep.(mn); $1.00(cy), 1(mn) OTS
1018	18-45170	Dep.(mn); $1.00(cy), 1(mn) OTS
ISS–	**(Italian)**	
63/50	18-43151	Dep.(mc)
64/6	18-44018	Dep.(mn)
64/22	18-44600	Dep.(mn)
64/25	18-44729	Dep.(mn)
64/26	18-43933	Dep.(mn)
JAERI–	**(Japanese)**	
1055	18-43758	Dep.(mn)
JPL-TR–	**(Non-AEC)**	
32-588	18-44136	$1.10(OTS) J. Less-Common Metals, 7: 278-87(1964)
JPRS–	**(Non-AEC)**	
26497	18-45036	$2.00(OTS)
26574	18-43323	$3.00(OTS)
26803	18-45197	$1.00(OTS)
K-DP–		
364	18-44019	Dep.(mn); $2.00(cy), 1(mn) OTS
KAPL–		
3031	18-44138	Dep.(mn); $2.00(cy), 1(mn) OTS
3036	18-44139	Dep.(mn); $2.00(cy), 1(mn) OTS
KAPL-M–		
6151	18-44705	Dep.(mn); $2.00(cy), 1(mn) OTS
6166	18-43373	Dep.(mn); $1.00(cy), 1(mn) OTS
6172	18-44086	Dep.(mn); $1.00(cy), 1(ma) OTS
6175	18-44706	Dep.(mn); $2.00(cy), 1(mn) OTS
6184	18-44140	Dep.(mn); $1.00(cy), 1(mn) OTS

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6186	18-44971	Dep.(mn); $4.00(cy), 3(mn) OTS
6192	18-43772	Dep.(mn); $2.00(cy), 1(mn) OTS
6193	18-44730	Dep.(mn); $1.00(cy), 1(mn) OTS
KIR-N–		
14	18-44974	See TID-21190
KLX–	**(Misc.)**	
1752	18-43711	Dep.(mn)
LA–		
3119	18-43888	Dep.; $4.00(cy), 2(mn) OTS
3132-MS	18-43152	Dep.; $6.00(cy), 6(mn) OTS
3135	18-43376	Dep.; $1.00(cy), 1(mn) OTS
3163-MS	18-45002	Dep.; $1.00(cy), 1(mn) OTS
LA-DC–		
5724	18-44287	Dep.(mn); $1.00(cy), 1(mn) OTS
6091	18-44422	Dep.(mn); $1.00(cy), 1(mn) OTS
6098	18-44731	Dep.(mn); $3.00(cy), 2(mn) OTS
6106	18-44280	$1.00(cy), 1(mn) OTS
6117	18-44423	Dep.(mn); $1.00(cy), 1(mn) OTS
6545	18-44319	$1.00(cy), 1(mn) OTS
LA-tr–		
64-27	18-44066	Dep.(mn); $3.60(fs), $1.22(mf) JCL
LADC–		
5611	18-45171	Dep.(mn); $1.00(cy), 1(mn) OTS
6123	18-43478	J. Chem. Phys., 41: 2869-76(1964)
6142	18-44026	Health Phys., 10: 817-22(1964)
6161	18-43259	Health Phys., 10: 709-13(1964)
6189	18-44752	Health Phys., 10: 764(1964)
6317	18-43491	J. Phys. Chem., 68: 2720-2(1964)
6441	18-43911	Nucl. Instr. Methods, 30: 154-6(1964)
6452	18-44798	Nucl. Phys., 60: 433-40(1964)
6462	18-43493	J. Phys. Chem., 68: 3040-2(1964)
LAMS–		
3030	18-44518	Dep.(mn); $1.00(cy), 1(mn) OTS
MAB–	**(Non-AEC)**	
199-M(2)	18-44040	
MATT–		
273	18-44852	Dep.(mn); $2.00(cy), 1(mn) OTS
293	18-44041	Dep.(mn); $1.00(cy), 1(mn) OTS
MCW–		
1486	18-44141	Dep.; $1.00(cy), 1(mn) OTS
MIT–	**(Misc.)**	
952-1	18-43221	Dep.(mn); $7.00(cy), 5(mn) OTS
2098-55	18-44601	Dep.(mn); $1.00(cy), 1(mn) OTS
2098-63	18-44561	Phys. Rev. Letters, 13: 486-9(1964)
2344-1	18-44972	Dep.(mn); $7.00(cy), 5(mn) OTS
MITNE–	**(Misc.)**	
49	18-44972	See MIT-2344-1
ML–	**(Misc.)**	
1214	18-44853	Dep.(mn); $3.00(cy), 1(mn) OTS
1215	18-44854	
1216	18-44855	Dep.(mn); $2.00(cy), 1(mn) OTS
ML-TDR–	**(Non-AEC)**	
64-217	18-44096	$6.00(fs), $1.25(mf) OTS
64-228	18-44097	OTS
MLM–		
1190	18-45172	Dep.; $7.52(cy), 7(mn) OTS
1203	18-45173	Dep.; $1.00(cy), 1(mn) OTS
1204	18-45174	Dep.; $1.00(cy), 1(mn) OTS
1209	18-45175	Dep.; $1.00(cy), 1(mn) OTS
1210	18-43803	Dep.; $1.00(cy), 1(mn) OTS
MND–	**(Misc.)**	
2706-12	18-45024	Dep.(mn); $4.00(cy), 3(mn) OTS
2812	18-44496	Dep.(mn); $3.00(cy), 2(mn) OTS
2812-2	18-44497	Dep.(mn); $3.00(cy), 2(mn) OTS
2812-3	18-44498	Dep.(mn); $2.00(cy), 1(mn) OTS
2812-4	18-44499	Dep.(mn); $2.00(cy), 1(mn) OTS
MR-N–	**(Non-AEC)**	
307	18-44238	See NARF-63-14T
N–	**(Misc.)**	
64-14868	18-44481	See EFINS-63-68
64-17689	18-44421	See GCA-TR-64-1-N
64-23945	18-44136	See JPL-TR-32-588
64-28051	18-44142	See NASA-CR-54123
NAA-SR-Memo–		
8685	18-45075	Dep.(mn); $4.00(cy), 2(mn) OTS
9886	18-44707	Dep.(mn); $1.00(cy), 1(mn) OTS
9963	18-43740	Dep.(mn); $2.00(cy), 1(mn) OTS
9965	18-44708	Dep.(mn); $4.00(cy), 3(mn) OTS
10008	18-44021	$4.00(cy), 4(mn) OTS
10084	18-43890	Dep.(mn); $2.00(cy), 1(mn) OTS
NARF–	**(Non-AEC)**	
63-14T	18-44238	$2.00(fs), $0.50(mf) OTS
NASA-CR–	**(Misc.)**	
54123	18-44142	$4.60(ph) OTS
55438	18-44481	See EFINS-63-68
55949	18-44421	See GCA-TR-64-1-N
NASA-SP–	**(Misc.)**	
50	18-44371	The Physics of Solar Flares. Proceedings of AAS-NASA Symposium Held at the Goddard Space Flight Center, Greenbelt, Maryland, October 28–30, 1963. Washington, D. C., National Aeronautics and Space Administration, 1964. $3.25 (GPO)
NASA-TN–	**(Misc.)**	
D-2004	18-44500	$1.00(OTS)
NAVWEPS–	**(Non-AEC)**	
8490	18-44424	$2.25(OTS)
NBL–		
215	18-43377	Dep.; $3.00(cy), 1(mn) OTS
NEVIS–	**(Misc.)**	
123	18-44519	Dep.(mn); $3.00(cy), 2(mn) OTS
125	18-44520	Dep.(mn); $3.00(cy), 2(mn) OTS
NLCO–		
920	18-43378	Dep.; $3.00(cy), 2(mn) OTS
921	18-43384	Dep.(mn); $2.00(cy), 1(mn) OTS
NMI–	**(Misc.)**	
2130	18-44042	Dep.(mn); $2.00(cy), 1(mn) OTS
2131	18-44043	Dep.(mn); $2.00(cy), 1(mn) OTS
NOTS-TP–	**(Non-AEC)**	
3460	18-44424	See NAVWEPS-8490
NP–	**(AEC File No. for Non-AEC Reports)**	
11895	18-43713	Dep.(mn); $1.00(cy), 1(mn) OTS
14264	18-44733	Dep.(mn)
14265	18-43937	Dep.(mn)
14266	18-44734	Dep.(mn)
14267	18-45025	Dep.(mn)
14290(Pt.A)	18-45026	Dep.(mn); $2.00(cy), 1(mn) OTS
14320	18-43804	Dep.(mn)
14345	18-44320	Dep.(mn)
14347	18-44288	
14367	18-44933	Dep.(mn)
14368	18-45027	Dep.(mn)
14369	18-44009	Dep.(mn)
14379	18-44602	Dep.(mn)
NP-tr–	**(AEC File No. for Non-AEC Translations)**	
1183	18-43745	Dep.(mn); $2.60(fs), $1.07(mf) JCL
NRL–	**(Misc.)**	

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6124	18-44735	$0.50(OTS)
NTD–		
6317R	18-44862	For translation see UCRL-Trans-1077(L)
NUC-E–	**(Non-AEC)**	
15	18-44917	$4.60(OTS)
NYO–		
1727-1	18-43223	Dep.(mn); $1.00(cy), 1(mn) OTS
2558-1	18-44144	Dep.(mn); $1.00(cy), 1(mn) OTS
10544(Rev.)	18-45176	Dep.(mn); $2.00(cy), 1(mn) OTS
ORNL–		
1993(Rev.2)	18-43714	Dep.; $2.00(cy), 2(mn) OTS
3670	18-44044	Dep.; $7.00(cy), 5(mn) OTS
3692	18-44736	Dep.; $3.00(cy), 2(mn) OTS
3693	18-43715	Dep.; $2.00(cy), 1(mn) OTS
ORNL-P–		
2	18-44105	Dep.(mn); $2.00(cy), 1(mn) OTS
17	18-44886	J. Nuclear Energy, Pt. C, 6: 513-14(1964)
49	18-44892	Phys. Rev., 136: A689-95(1964)
57	18-43494	J. Phys. Chem., 68: 3043-8(1964)
184	18-43956	J. Nucl. Med., 5: 653-6(1964)
207	18-43208	Proc. Natl. Acad. Sci. U. S., 52: 661-2 (1964)
226	18-44057	Dep.(mn); $2.00(cy), 1(mn) OTS
238	18-43361	Dep.(mn); $1.00(cy), 1(mn) OTS
249	18-44106	Dep.(mn); $2.00(cy), 1(mn) OTS
296	18-44425	Dep.(mn); $1.00(cy), 1(mn) OTS
311	18-44918	Dep.(mn); $1.00(cy), 1(mn) OTS
313	18-43716	Dep.(mn); $1.00(cy), 1(mn) OTS
321	18-43362	Dep.(mn); $1.00(cy), 1(mn) OTS
322	18-43320	Dep.(mn); $1.00(cy), 1(mn) OTS
324	18-43445	Dep.(mn); $1.00(cy), 1(mn) OTS
325	18-45087	Dep.(mn); $1.00(cy), 1(mn) OTS
346	18-43224	Dep.(mn); $1.00(cy), 1(mn) OTS
350	18-43321	Dep.(mn); $1.00(cy), 1(mn) OTS
351	18-44058	Dep.(mn); $1.00(cy), 1(mn) OTS
365	18-45030	Dep.(mn); $2.00(cy), 1(mn) OTS
388	18-43225	Dep.(mn); $1.00(cy), 1(mn) OTS
391	18-43717	Dep.(mn); $2.00(cy), 1(mn) OTS
394	18-43226	Dep.(mn); $1.00(cy), 1(mn) OTS
400	18-44291	Dep.(mn); $1.00(cy), 1(mn) OTS
406	18-44059	$2.00(cy), 1(mn) OTS
419	18-43227	Dep.(mn); $1.00(cy), 1(mn) OTS
422	18-43185	Dep.(mn); $1.00(cy), 1(mn) OTS
425	18-44153	Dep.(mn); $1.00(cy), 1(mn) OTS
427	18-44107	Dep.(mn); $1.00(cy), 1(mn) OTS
428	18-44292	Dep.(mn); $1.00(cy), 1(mn) OTS
437	18-43938	Dep.(mn); $1.00(cy), 1(mn) OTS
445	18-45177	Dep.(mn); $2.00(cy), 1(mn) OTS
447	18-43385	Dep.(mn); $2.00(cy), 1(mn) OTS
449	18-43228	Dep.(mn); $2.00(cy), 1(mn) OTS
456	18-44856	Dep.(mn); $1.00(cy), 1(mn) OTS
472	18-43229	Dep.(mn); $1.00(cy), 1(mn) OTS
473	18-43386	Dep.(mn); $3.00(cy), 1(mn) OTS
479	18-43387	Dep.(mn); $2.00(cy), 1(mn) OTS
482	18-43891	Dep.(mn); $1.00(cy), 1(mn) OTS
483	18-45178	Dep.(mn); $2.00(cy), 1(mn) OTS
488	18-44676	Dep.(mn); $1.00(cy), 1(mn) OTS
490	18-43186	Dep.(mn); $1.00(cy), 1(mn) OTS
ORNL-TM–		
627	18-45088	Dep.(mn); $3.00(cy), 2(mn) OTS
803	18-43159	Dep.(mn); $3.00(cy), 2(mn) OTS
914	18-45089	Dep.(mn); $4.00(cy), 3(mn) OTS
924	18-43230	Dep.(mn); $3.00(cy), 2(mn) OTS
930	18-44737	Dep.(mn); $1.00(cy), 1(mn) OTS
ORNL-tr–		
290	18-44067	Dep.(mn); $1.10(fs), $0.80(mf) JCL
334	18-43547	Dep.(mn); $1.10(fs), $0.80(mf) JCL
ORO–		
619	18-43741	Dep.; $4.00(cy), 2(mn) OTS
PAN–	**(Polish)**	
102/IX	18-44973	Dep.
103/IX	18-45090	Dep.
416/XII	18-45091	Dep.
419/XI	18-45092	
421/Doz.XI	18-45093	Dep.
422/Doz.XI	18-45004	Dep.
500/VI	18-44814	Nucl. Phys., 60: 654-65(1964)
PATENTS	**(French)**	
76,904	18-43767	See French Patent 1,226,456(Add.1)
1,214,753	18-44230	
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1,248,874	18-43768	
1,267,627	18-43535	
1,283,658	18-44123	
1,285,420	18-44124	
1,285,781	18-43769	
1,287,168	18-44951	
1,288,316	18-45071	
1,304,439	18-44125	
1,312,623	18-44952	
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1,326,447	18-44959	
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1,338,868	18-44995	
1,341,433	18-44996	
1,344,054	18-44966	
1,344,634	18-44997	
1,345,745	18-45073	
PATENTS	**(German)**	
1,126,253	18-43834	For French translation see CEA-tr-A-1514
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PATENTS	**(U. S.)**	
3,145,956	18-45199	
3,146,622	18-45200	
3,147,088	18-44094	
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3,149,043	18-45009	
3,149,044	18-45146	
3,149,047	18-44967	
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3.150.281	18-45201	
3.150.291	18-43755	
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3.150.936	18-44128	
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3.151.029	18-44999	
3.151.034	18-45000	
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3.152.984	18-45159	
3.153.482	18-45202	
3.153.850	18-45203	
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3.154.376	18-43735	
3.154.378	18-43540	
3.154.379	18-43736	
3.154.408	18-43737	
3.154.500	18-45160	
3.154.501	18-44008	
PIBMRI–	**(Non-AEC)**	
1165-63	18-44857	$1.50(OTS)
PNE–		
234F	18-43789	Dep.; $4.00(cy), 2(mn) OTS
PUC–		
1964-143	18-44778	Nucl. Phys., 60: 35-48(1964)
R–	**(Misc.)**	
232	18-44673	See AD-604097
445	18-44520	See NEVIS-125
2277	18-43709	See EURAEC-972
2290	18-43710	See EURAEC-1153
RADC-TDR–	**(Misc.)**	
64-110	18-44857	See PIBMRI-1165-63
64-117	18-44858	$5.00(OTS)
RFP–		
420	18-43388	Dep.; $1.00(cy), 1(mn) OTS
421	18-44060	Dep ; $1.00(cy), 1(mn) OTS
424	18-43389	Dep.; $1.00(cy), 1(mn) OTS
425	18-43742	$2.00(cy), 1(mn) OTS
431	18-43322	Dep.(mn); $1.00(cy), 1(mn) OTS
RFX–	**(Swedish)**	
97	18-43939	Dep.(mn)
RM–	**(Misc.)**	
3942-PR	18-44022	$1.00(OTS)
RPI–	**(Misc.)**	
2325-1	18-43446	Dep.(mn); $7.10(cy), 8(mn) OTS
RPM-RFX–	**(Swedish)**	
228	18-44937	For translation see ANL-Trans-79
RRL–		
134	18-43641	J. Phys. Chem., 68: 2697-2703(1964)
137	18-43642	J. Phys. Chem., 68: 2714-16(1964)
RSIC–	**(Non-AEC)**	
150(Vol.II(App.A)	18-44239	$6.00(OTS)
RT-BIO–	**(Italian)**	
(63)38	18-43298	p.25-43 of "Progresso Agricolo e Scienze Nucleari." Florence, Officine Grafiche Vallecchi, 1963
SAN–		
1023	18-43160	Dep.; $4.00(cy), 2(mn) OTS
SC-DC–		
3550	18-45181	Dep.(mn); $2.00(cy), 1(mn) OTS
64-348	18-44154	Dep.(mn); $3.00(cy), 2(mn) OTS
64-1450	18-45179	Dep.(mn); $2.00(cy), 1(mn) OTS
64-1453	18-45180	Dep.(mn); $1.00(cy), 1(mn) OTS
64-1517X	18-43743	Dep.(mn); $5.00(cy), 3(mn) OTS
SC-R–		
747	18-45186	Dep.(mn); $1.00(cy), 1(mn) OTS
64-145A	18-45182	Dep.(mn); $1.00(cy), 1(mn) OTS
64-175	18-45183	Dep.(mn); $1.00(cy), 1(mn) OTS
64-176	18-45184	Dep.; $1.00(cy), 1(mn) OTS
64-178	18-43892	Dep.(mn); $1.00(cy), 1(mn) OTS
64-1319	18-45185	Dep.(mn); $1.00(cy), 1(mn) OTS
64-1330	18-44061	Dep.(mn); $1.00(cy), 1(mn) OTS
SC-T–		
64-1607	18-43451	Dep.(mn); $1.60(fs), $0.80(mf) JCL
64-1608	18-43363	Dep.(mn); $1.60(fs), $0.80(mf) JCL
SC-TM–		
64-981	18-45187	Dep.(mn); $2.00(cy), 1(mn) OTS
64-987	18-45188	Dep.(mn); $1.00(cy), 1(mn) OTS
SCDC–		
3097	18-43946	See TID-18404
SGAE-BL–	**(Austrian)**	
8/1964	18-43327	Naturwissenschaften, 51: 385-6(1964)
SLAC-PUB–		
31	18-44615	J. Math Phys. (N. Y.), 5: 1427-30(1964)
48	18-44321	Dep.(mn); $1.00(cy), 1(mn) OTS
49	18-44322	Dep.(mn); $1.00(cy), 1(mn) OTS
SLAC-Trans–		
10	18-43900	Dep.(mc); $1.00(cy), 1(mn) OTS; $2.60(fs), $0.86(mf) JCL
SRO–		
106	18-45031	Dep.(mn); $1.00(cy), 1(mn) OTS
107	18-45032	Dep.(mn); $1.00(cy), 1(mn) OTS
SSD-TDR–	**(Non-AEC)**	
63-77	18-44643	$5.60(OTS)
SU-SEL–		
64-036	18-44859	Dep.(mn); $2.00(cy), 1(mn) OTS
TDR–	**(Non-AEC)**	
169(3260)TN-1	18-44643	See SSD-TDR-63-77
TE–	**(Non-AEC)**	
60-64	18-44501	$4.60(OTS)
THAI-AEC–	**(Thailand)**	
2	18-45094	Dep.(mn)
TID–		
3909(Suppl.2)	18-43805	Dep.; $1.00(cy), 1(mn) OTS
7697	18-45095	Dep.; $9.58(cy), 10(mn) OTS
7699	18-45151	Dep.; $3.00(cy), 3(mn) OTS
18404	18-43946	Commun. ACM (Assoc. Computing Machinery), 7: 34-8(1964)
19201	18-43447	Dep.(mn); $1.00(cy), 1(mn) OTS
19605	18-43187	Dep.(mn); $2.00(cy), 1(mn) OTS
19659	18-43797	Soil Sci., 98: 181-6(1964)
19758	18-45189	Dep.(mn); $1.00(cy), 1(mn) OTS
19880	18-44983	Nucl. Sci. Eng., 20: 266-71(1964)
20161	18-43665	Radiation Res., 23: 319-29(1964)
20533	18-44490	Nucl. Sci. Eng., 20: 307-13(1964)
20591	18-44629	Nuovo Cimento (10), 34: 442-9(1964)
20643	18-43390	Dep.; $2.00(cy), 1(mn) OTS
20680	18-44803	Nucl. Phys., 60: 509-17(1964)
20788	18-43337	J. Lab. Clin. Med., 64: 560-73(1964)
20910	18-43168	See CONF-147-12
20980	18-45155	Dep.(mn); $3.00(cy), 2(mn) OTS
21007	18-43601	Dep.(mn); $3.00(cy), 1(mn) OTS
21015	18-45190	Dep.; $3.00(OTS)
21123	18-43626	J. Am. Chem. Soc., 86: 3954-7(1964)
21137	18-43790	Dep.(mn); $2.00(cy), 1(mn) OTS
21141	18-43546	Dep.(mn); $1.00(cy), 1(mn) OTS
21149	18-44860	Dep.(mn); $5.00(cy), 3(mn) OTS
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21191	18-43760	Dep.(mn); $1.00(cy), 1(mn) OTS
21200	18-43188	Dep.(mn); $1.00(cy), 1(mn) OTS
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21204	18-43232	Dep.(mn); $1.00(cy), 1(mn) OTS
21205	18-44521	Dep.(mn); $3.00(cy), 2(mn) OTS
TPM-RFX–	**(Swedish)**	
108	18-43899	For translation see ANL-Trans-77
TT–	**(Canadian)**	
64-41755	18-45036	See JPRS-26497
64-41832	18-43323	See JPRS-26574
64-51060	18-45197	See JPRS-26803
UAG-R–	**(Non-AEC)**	
154	18-44644	
UCRL–		
7591	18-44063	Dep.(mn); $2.00(cy), 1(mn) OTS
7752(Rev.I)	18-45193	Dep.(mn); $1.00(cy), 1(mn) OTS
7900-T(Rev.)	18-44463	Proc. Phys. Soc. (London), 84: 453-4(1964)
7963	18-43747	Dep.(mn); $2.00(cy), 1(mn) OTS
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11304	18-43401	J. Geophys. Res., 69: 4247-55(1964)
11400	18-44810	Nucl. Phys., 60: 593-608(1964)
11402	18-44738	Dep.(mn); $2.00(cy), 1(mn) OTS
11407	18-44861	Dep.(mn); $4.00(cy), 3(mn) OTS
11418	18-44156	$4.00(cy), 2(mn) OTS
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11568	18-44523	Dep.(mn); $3.00(cy), 2(mn) OTS
11588	18-44158	Dep.(mn); $2.00(cy), 1(mn) OTS
11598	18-44739	Dep.(mn); $4.00(cy), 3(mn) OTS
11665	18-44427	Dep.(mn); $3.00(cy), 2(mn) OTS
11682	18-44564	Phys. Rev. Letters, 13: 495-7(1964)
12033	18-44740	Dep.(mn); $1.00(cy), 1(mn) OTS
12074-T	18-44893	Phys. Rev. Letters, 13: 464-7(1964)
13062	18-43761	Dep.(mn); $3.00(cy), 3(mn) OTS
13124	18-45168	See EMRL-24
UCRL-Trans–		
1077(L)	18-44862	Dep.(mn); $1.00(cy), 1(mn) OTS; $1.00(fs), $0.80(mf) JCL
1084(L)	18-44863	Dep.(mn); $1.00(cy), 1(mn) OTS; $1.10(fs), $0.80(mf) JCL
UJV–	**(Czechoslovakian)**	
1109/64	18-45156	Dep.(mc)
1113/64	18-43448	Dep.(mc)
UR–		
649	18-43233	Dep.; $1.00(cy), 1(mn) OTS
URS–	**(Non-AEC)**	
640-4	18-43806	$1.25(OTS)
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1008	18-44281	Dep.; $2.00(cy), 1(mn) OTS
WAC–	**(Non-AEC)**	
138/011	18-44236	See ERDE-12/R/62
WAL-TR–	**(Non-AEC)**	
834.2/11-3	18-44159	
WAPD–	**(Misc.)**	
282	18-44064	Dep.; $1.00(cy), 1(mn) OTS
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109	18-45034	Dep.; $4.00(cy), 3(mn) OTS
WAPD-T–		
1634	18-44709	Dep.(mn); $1.00(cy), 1(mn) OTS
1671	18-45057	Nucl. Sci. Eng., 20: 338-51(1964)
1685	18-44024	Dep.(mn); $2.00(cy), 1(mn) OTS
1701	18-44025	Dep.(mn); $1.00(cy), 1(mn) OTS
1716	18-44204	Nature, 203: 1163-5(1964)
WAPD-TM–	**(Misc.)**	
432	18-44160	Dep.; $1.00(cy), 1(mn) OTS
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2647	18-45035	Dep.(mn); $3.00(cy), 1(mn) OTS
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